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BULLETIN No. 6

A Mill Scale Study

of

Western Yellow Pine

CALIFORNIA
STATE PRINTING OFFICE
1918

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STATE BOARD OF FORESTRY

BULLETIN No. 6

A Mill Scale Study
OF
Western Yellow Pine

By HERMAN E. McKENZIE

CALIFORNIA
STATE PRINTING OFFICE
1915

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PLATE I. A Typical Stand of Immature and Mature Western Yellow Pine.

INTRODUCTION.

THE solutions of many of the numerous problems encountered in the economic management of merchantable forests depend upon the present and probable future market conditions; the present and probable future cost of logging, milling and transportation; and upon a definite knowledge of the quality and quantity of lumber contained in trees of various sizes, along with the yearly increase in quality and quantity due to growth.

The question often arises: Is it more profitable to leave certain trees standing than to cut them down and invest the profits obtained thereby, or is it more profitable to allow them to grow and accumulate interest in the form of wood added each year, along with a possible increase in value due to change in market conditions, or perhaps to future betterment of transportation facilities? Such questions can not intelligently be dealt with unless at least the quality and quantity of trees of different sizes, as well as yearly increase in both quality and quantity of lumber contained in them, be quite definitely known. It is the object of this study to make such determinations for western yellow pine that can be used in the solution of the above and similar problems; also, that can be used in connection with more accurate valuation surveys than have been made in the past, and which will help lumbermen and timber owners in general to more economically formulate their policies of handling merchantable yellow pine forests.

The study is based upon nine hundred and nineteen trees, ranging from twenty to forty-four inches in diameter breasthigh, five hundred and seven of which were classified, according to outward appearances, as bull pine, and four hundred and twelve as typical yellow pine. A complete analysis of quality and quantity of lumber produced from these trees, also from the butt logs, the best part, and the top logs, the poorest part of the trees, has been made and the results arranged on opposite pages throughout this bulletin, so that a comparison of the two forms may be had. The values shown in the tables in Part III were read from the curves shown in Part II, which were in turn plotted directly from averages obtained from the original data. References are made with each table, such that it is possible to trace any value there recorded back to its original derivation.

Each feature has been presented in detail and will be of direct value to lumbermen operating in pine forests under similar conditions. Yellow pine stands constitute the predominating forest type in California and, consequently, this type affords a characteristic set of conditions under which to initiate such a piece of work. Prepared thus in detail, it offers to lumbermen in other types of forest a valuable outline for the accomplishment of similar investigations, since most of the determinations herein are unaffected by varying conditions, such as market fluctuations and transportation facilities, and since all the principles can be made to apply to money values which are modified from year to year.

PART I—FIELD WORK.

THE STAND.

At an elevation of 5,400 feet and growing in soil rich in moisture and of volcanic origin, the forest in which this mill scale study was conducted consisted of a stand in which western yellow pine (*Pinus ponderosa*) predominated in association with a conspicuous growth of white fir (*Abies concolor*) and an occasional Douglas fir (*Pseudotsuga taxifolia*). The forest, located in the southern part of Lassen County, California, is being exploited by the Red River Lumber Company. The local topography is characteristically level with conspicuous rock outcroppings so frequently encountered in sections of the yellow pine and sugar pine regions of California. The uneven-aged stand cruises approximately 25,000 board feet to the acre, and is characterized by the presence of two distinct forms of yellow pine: namely, "yellow pine," averaging in height about 130 feet, and "bull pine" or "blackjack," having an average height of approximately 120 feet. Although locally known by these names, the two forms have been studied separately and are referred to respectively as "mature yellow pine" and "immature yellow pine," since it is believed that the variance is due solely to a difference in age of trees of the same diameters.

The rainfall is abundant but not heavy, and several small streams drain the area and flow throughout the year. The region is one of an open forest, free from abundant low growing species, and is further characterized by numerous small mountain meadows, open glades in which grass constitutes the main vegetation; these meadows vary in size, but seldom exceed twenty acres in extent except for the very large meadows, which are frequently several miles across.

The stand consists of trees of good quality, free from defects except for the general fire-scarred butts which give evidence of past fires. These scars are healed over and do not materially affect the quality of the stand. The average age of the two forms of yellow pine are respectively 350 and 250 years. The average diameter of the mature yellow pine is about thirty-six inches and for the immature yellow pine about twenty-eight inches.

THE MILL.

The mill operated by the Red River Lumber Company on its holdings at Westwood, Lassen County, during the summer of 1913, was of modern band-saw type, electrically equipped with separate motor drives for each piece of machinery. Its capacity was 50,000 board feet for an eleven-hour shift. The saw used was 16 gauge and 12 swedge—one-tenth inch thick with cutting edge one-eighth inch wide. The log carriage was "shotgun" type limited to logs of not less than eight feet and not more than twenty-four feet in length. The diameter of the largest log that could be sawed was forty-six inches at the large end.

These features of the mill influenced to a marked degree the final results of the study, and are the only ones pertaining to the mill proper deemed of importance in connection with this work.

PARTY AND EQUIPMENT.

[illegible] equipment of the men is shown [illegible]

[illegible]

[illegible] with each crew, and [illegible] calipers; [illegible] sharp knife [illegible] same as shown in Plate [illegible]

In the woods.

Two members of party with each bucking team and equipped as follows: [illegible] measuring [illegible] feet and tenths of inches; [illegible] stem analysis [illegible] feet and tenths in the one [illegible] inches and twentieths in the other; [illegible] and two pads of blank forms as shown in Plates II and III, one for recording stem analysis data and the other for recording log measurements.

Stationed at log deck.

[illegible] recorded on separate pad the volume in board feet as shown by the Spaulding Log Scale of each marked log sent up the log carriage to be milled.

At the mill.

Stationed at saw.

One member of party equipped with blue lumber crayon for marking first and last board from each marked log and blank pad for recording numbers of logs sawed from them.

Stationed at grading table.

One member of party equipped with pad of blank forms as shown in Plates IV to X, who recorded the volume and grade of lumber from each marked log as called off to him by the company's grader as he entered same on his tally sheet.

The mill was operated with day and night shifts, therefore two members of the party were required to do night work, thus making four men in all stationed at the mill.

METHOD OF PROCEDURE.

In the Woods.

Identification.

The men stationed with the falling crews identified all trees to be included in the study before they were felled. All trees included were western yellow pine, but of two varieties known locally as typical yellow pine and bull pine, or blackjack. The identification of each tree was exactly the same as would have been made by the lumbermen of the locality, the determining characteristics being based on general outward appearances, mostly on color, and texture of bark. Trees identified as typical yellow pine had fairly smooth bark with furrows about one-half inch deep running both horizontally and longitudinally, thus forming rather large, smooth, irregular shaped plates, which were light brown in color with a tendency toward the shade of yellow. The top part of their crowns were dome-shaped. Trees identified as bull pine, or blackjack, had rough, dark colored, cork-like bark, which was almost black in some cases. Usually small limbs, either dead or alive, were present on the lower portion of the bole, and the top part of their crowns were cone-shaped.

Tree measurements.

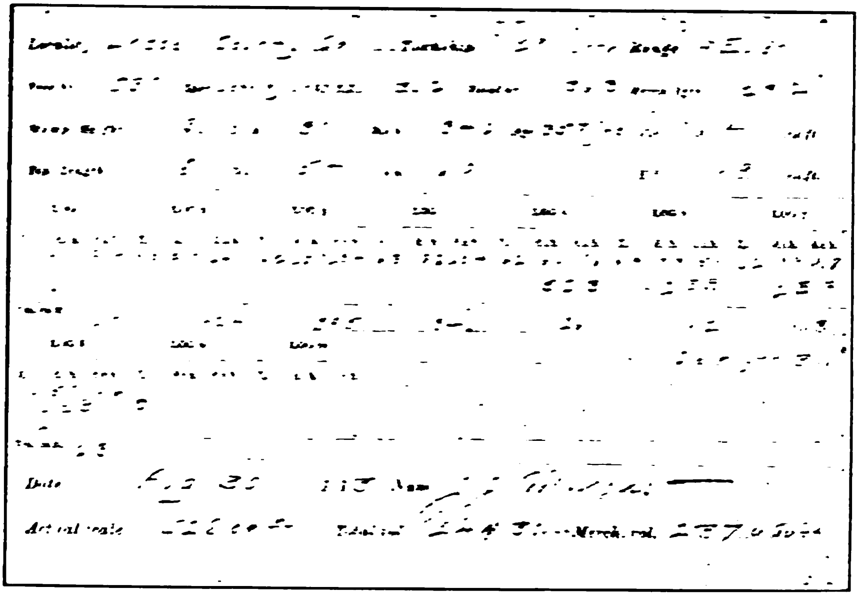
The first measurement made on each tree was diameter breasthigh in inches. This measurement, an average of the long and short diameters at right angles, was taken outside bark four and one-half feet from the ground while the trees were standing. Immediately after a tree was felled, it was given a number, which was marked plainly on the butt and also on the stump with blue lumber crayon. The clear length (the distance from the stump to the first limb or snag two inches or over in diameter), the merchantable length (the distance from the stump to where the tree was six inches in diameter outside bark), and the total height (the distance from the ground line to tip of crown) were then measured and recorded in their proper places on forms similar to the one shown in Plate II. The height of the stump was then taken, and the average radius determined.

Marking.

All trees were given a number and marked immediately after falling, and each stump was also marked with the same number as the tree. Trees identified as yellow pine were given consecutive numbers beginning with No. 1, which was the first tree identified; tree No. 2 the second identified, and so on. Trees classified as bull pine or blackjack were also given consecutive numbers, but each was preceded by a zero. Therefore, tree No. 01 indicated that the tree bearing this mark was the first measured and classified as bull pine; tree No. 02 the second, and so on. Logs cut from marked trees were given numbers which indicated the position the log held in the tree and also the number of the tree, For instance, if tree No. 425 were bucked into eight logs, beginning with the butt log, each would receive the following numbers: 4251, 4252, 4253, 4254, 4255, 4256, 4257 and 4258, the last digit of the number always indicating the position of the log in the tree. Log No. 4256 should be read the sixth log from stump of tree No. 425. The same scheme was used in numbering trees identified as bull pine. Should a log be marked 04256, the number would be translated as indicating the sixth log from the stump of tree No. 0425, which was identified as bull pine. All logs were marked plainly on both ends in blue lumber crayon with the number indicating the tree from which the log came and the position that the log occupied in the tree. Should one end of the log be broken instead of sawed, a place was smoothed off by means of a hand-axe and the number written plainly on it. In some cases logs were broken on both ends. Such logs were marked in two places, either on hewn surfaces on the broken ends or on places near each end of the log where the bark was hewn away for that purpose.

Growth measurements.

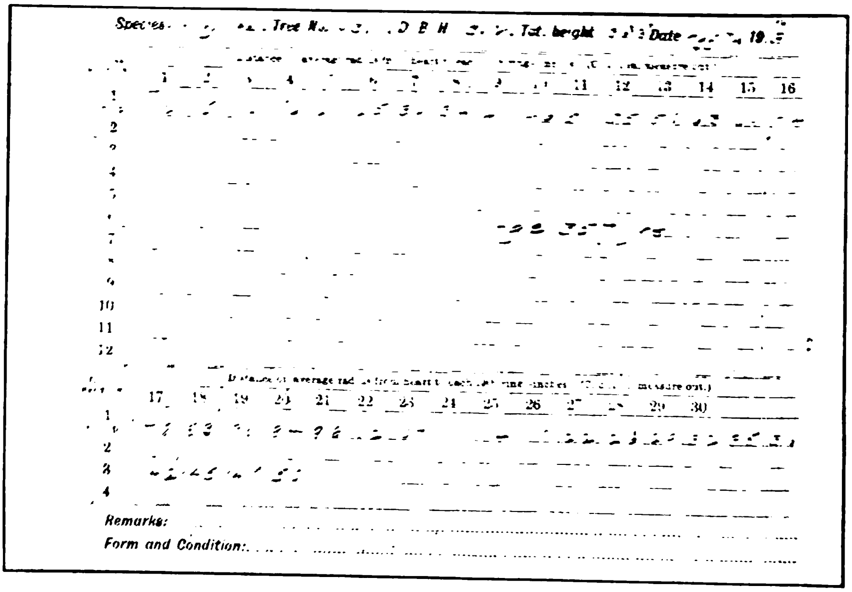
Growth measurements consisted of determination of the average radii inside the bark at the stump of all trees for each decade of their growth. The average radius inside bark of stump was ascertained by averaging the longest and shortest diameters to be found at right angles, and a



Date

Actual scale

PLATE II.—Woods Sheet for Tree No. 038.



Species ... Tree No. ... D B H ... Tot. height ... Date ... 19..

	[illegible]	[illegible]	[illegible]	4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	11	12	13	14	15	16
1																
2																
3																
4																
5																
6																
7																
8																
9																
10																
11																
12																

Distance of average radius from heart to each ... (inches ... measure out.)														
	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1														
2														
3														
4														

Remarks: ....

Form and Condition: ....

PLATE III.—Stump Analysis Sheet for Tree No. 038.

distance from the heart of the stump to the inside of the bark was then located which was equal to the average radius determined, and a line was drawn. Annual rings were then counted along this line, starting at the bark and continuing toward the heart. A mark was placed at every tenth ring until the heart of the stump was reached. The last division near the heart usually contained less than ten rings. The age of the tree was then determined by counting the marks and multiplying by ten and adding the number of rings between the pith and the last mark. For example, if there were thirty-one marks along the average radius, and seven rings included between the pith and the last mark made, the tree's age from the time it was as high as the stump until felled would be 317 years. Radii from the pith to each mark were measured and recorded. These distances represent the radius inside bark at the stump attained by the tree at each ten year interval of growth.

Recording of data.

All data was recorded on forms prepared especially for the work. Measurements made by the men working with the falling crews were recorded on forms similar to the one shown in Plate II. Log measurements made by members of the party working with the bunching teams were also recorded on these forms, which were turned over to them each night by the men located with the falling crews. Growth measurements were recorded on separate forms as shown in Plate III. All broken sections of trees were recorded whether they were fit for milling purposes or not, and were given numbers the same as though they were logs. In some cases such sections would not measure over two feet in length and perhaps broken on both ends. They were given log numbers, however, and recorded with the following symbols added 2 E.B. and L.I.W., meaning two ends broken and left in the woods. If only one end was broken, and it happened to be the small end, the notes would read S.E.B., L.I.W., meaning that the small end was broken and the large end was sawed; also that the section was left in the woods. If the large end was broken and the small end sawed, the symbols would be L.E.B., L.I.W., meaning large end broken, small end sawed and section left in the woods. In this way all broken sections were indicated in the data and all of each tree accounted for.

Log measurements.

The lengths of all logs were measured in feet and tenths, and the average diameter inside bark, in inches and tenths. The thickness of bark was determined by averaging measurements of same taken in three or four places. The diameter outside the bark was obtained by adding twice the thickness of the bark to the inside diameter.. Logs with broken ends were measured from an average of the break on one end to the average of the break on the other. The diameters of broken sections were measured in some cases with calipers, but whenever possible the measuring stick was used.

At the Mill

Log scale.

All marked logs reaching the mill were scaled by the company's log scaler, who scaled by the Spaulding Log Rule. An allowance of one linear foot was made for each broken end of broken logs, and the number of each log was recorded along with its log scale and dimensions.

Marking.

The first and last board from each log were marked conspicuously by the member of the party stationed near the edger, and each log was recorded as it came on to the carriage. By means of this systematic marking and recording it was possible to follow closely the output of lumber from each log and, ultimately, from each tree.

Grading.

The grading was done in accordance with the rules shown on page 20 by men of long experience. The contents and grade of each board coming from marked logs were called off by the grader as he entered them on his tally sheet, thus enabling one of the party to record the same in his specially designed form book.

Recording of data.

All data pertaining to grades and volume sawed out of marked logs of various sizes, were recorded by the man stationed at the grading table on forms as shown in Plates IV to X. The log number was first entered at the top of the sheet, then the volume in board feet of each piece of lumber sawed was entered under a heading denoting the grade. The total volume in board feet of each grade was then determined by adding the figures in each column. The total sawed out, which is the total volume of all grades, was obtained by adding the totals of each separate column. This grand total was recorded in the lower right-hand corner as shown in the above mentioned plates. The volume by the Spaulding Log Rule appears in the lower left-hand corner of each log sheet.

Dimensions of lumber.

Some of the lumber manufactured by the Red River Lumber Company was cut shy on dimensions. One-inch boards were sawed 15/16" in thickness, 6/4" boards were sawed 6/4" in thickness, 2" x 4" joists were sawed 1 3/4" x 4", 8/4" commons were sawed 1 3/4" in thickness. Large timbers were sawed with an allowance of 1/4" in both directions for shrinkage. All boards over 8" in width were sawed with an allowance of 1/4" for shrinkage. These deviations from true dimensions affect to some extent the total sawed out for each log, and therefore for each tree, and is one of the reasons why the mill over-run shown farther on is so uncommonly large.

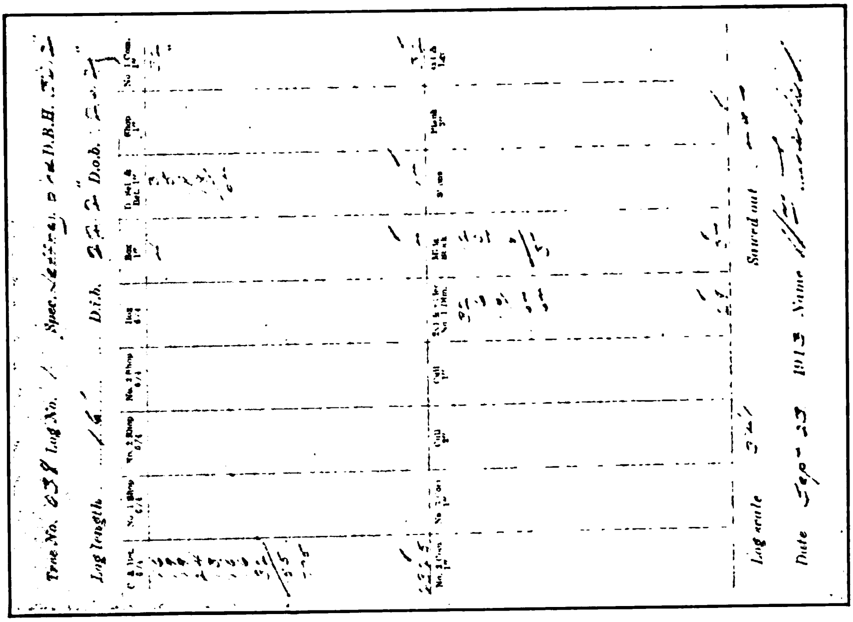
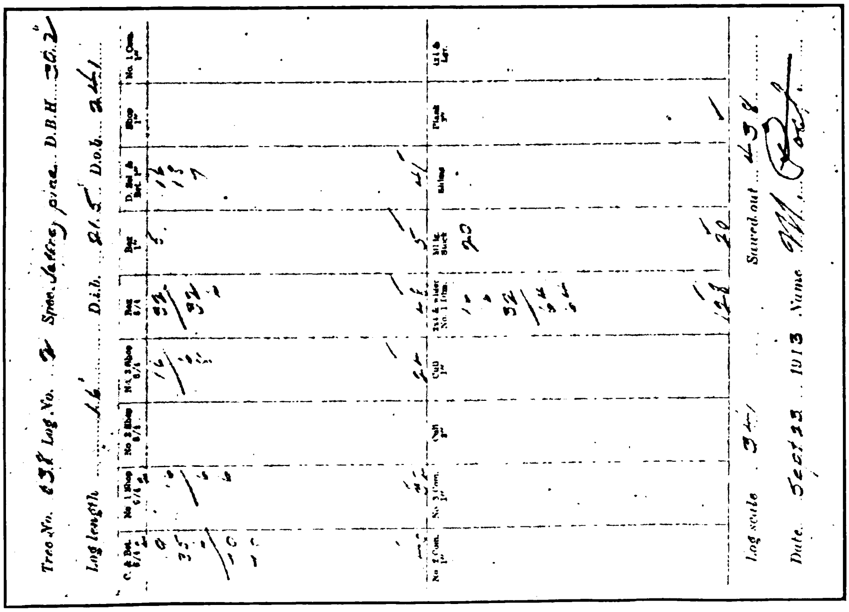


Plate IV.—Mill Sheet for Log No. 1, Tree No. 038.



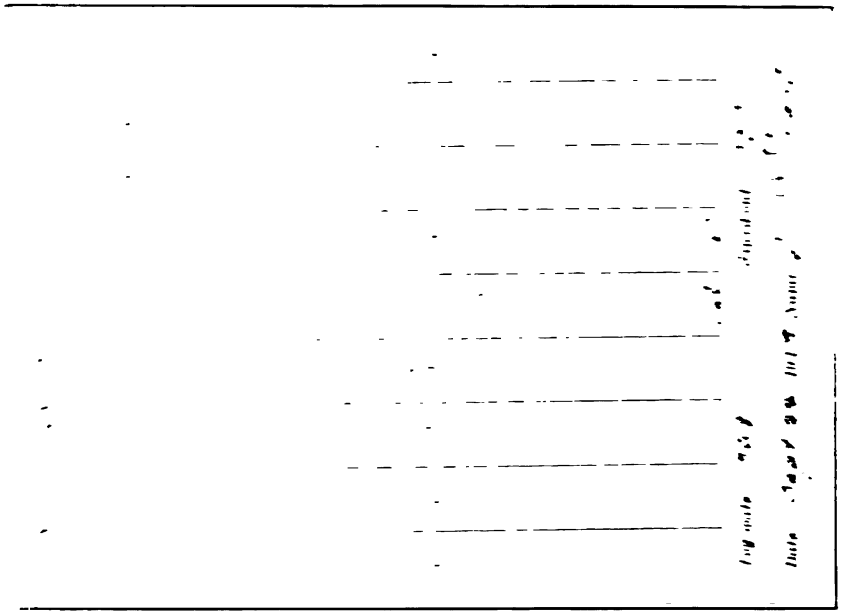
Tree No. 038 Log No. 2 Spec. Jeffrey pine D.B.H. 30.2"

Log length 16' D.i.b. 21.5" D.o.b. 24.1

Log scale 341 Sawed out 438

Date Sept 23 1913 Name

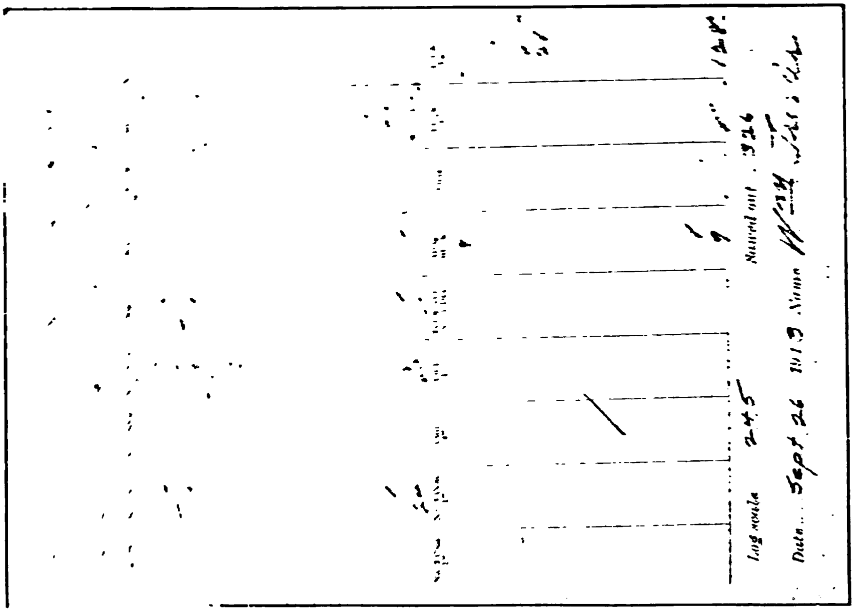
Plate V.—Mill Sheet for Log No. 2, Tree No. 038.



Log scale [illegible] Sawed out [illegible]

Date Sept 26 1913 Name [illegible]

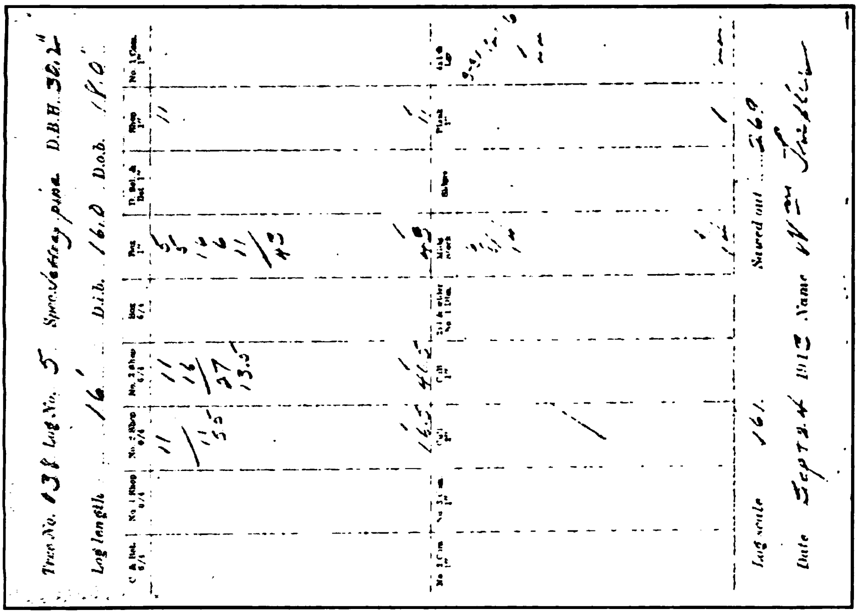
Plate VI.—Mill Sheet for Log No. 3, Tree No. 038.



Log scale 245 Sawed out 326

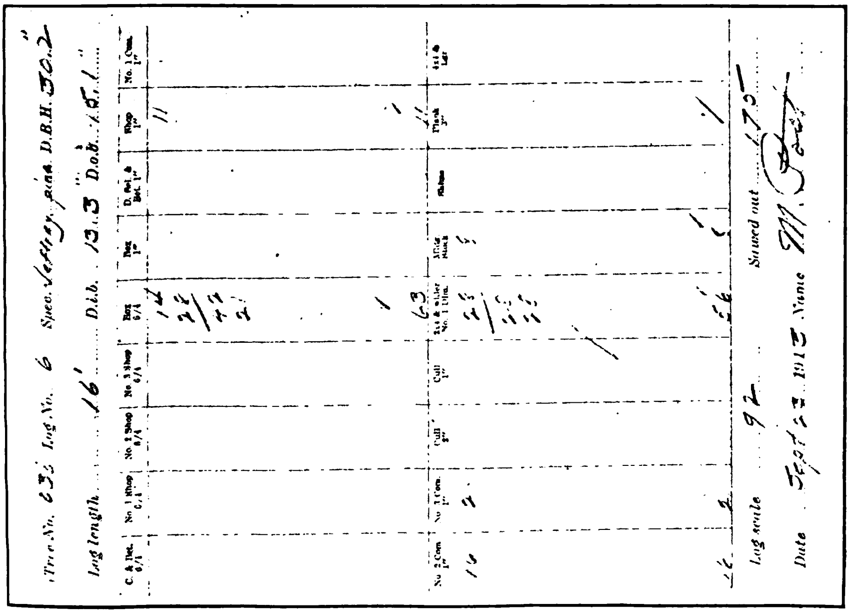
Date Sept 26 1913 Name [illegible]

Plate VII. Mill Sheet for Log No. 4, Tree No. 038.



Tree No. 038 Log No. 5 Spec. Jeffrey pine D.B.H. 30.2"
Log length 16' D.i.b. 16.0 D.o.b. 18.0"
Log scale 161 Saved out 269
Date Sept 24 1912 Name

PLATE VIII.—Mill Sheet for Log No. 5, Tree No. 038,



Tree No. 038 Log No. 6 Spec. Jeffrey pine D.B.H. 30.2"
Log length 16' D.i.b. 13.3" D.o.b. 15.1"
Log scale 92 Saved out 175
Date Sept 23 1912 Name

PLATE IX.—Mill Sheet for Log No. 6, Tree No. 038.

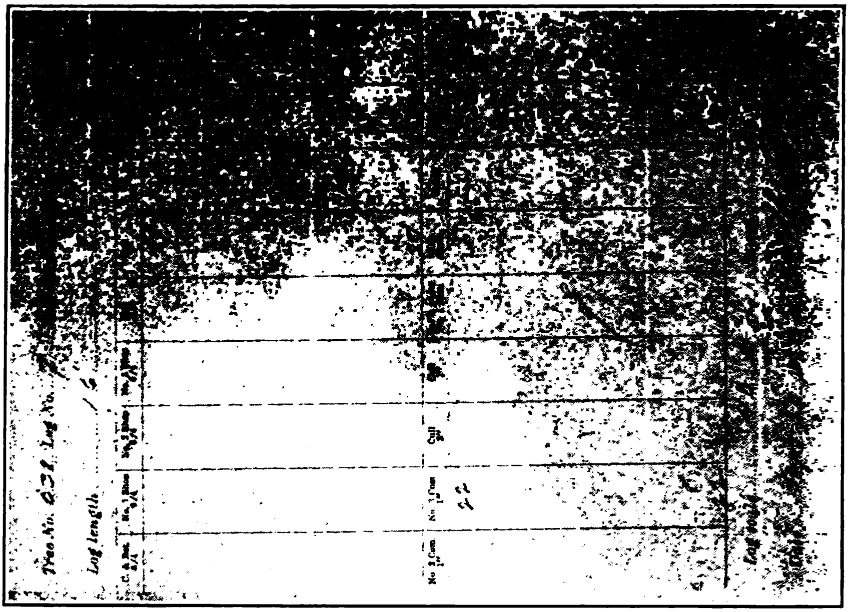


Plate X.—Mill Sheet for Log No. 7, Tree No. 038.

GRADING RULES.

Eastern grading rules were used by the Red River Lumber Company, and during this mill scale study the grading was observed very closely by the writer so that a clear description of each grade as applied to the lumber on the live chains could be given.

It will be seen from the description of the various grades which follow that each of them, with the exception of 2" x 4" and wider, 4" x 4" and larger, and 3" plank, specifies clearly lumber of a definite quality, their limitations being such that it is not possible to conscientiously crowd poor material into the upper grades. The grader will, of course, give lumber as high a mark as possible, since it is greatly to the interest of the company to have its good quality material graded as such. The rules given below do not prevent the good quality of lumber found in a log from being placed in a low grade, but they do prevent the poor quality from entering the high grades. Therefore, on the one hand, the grader makes his mark of quality as high as possible and, on the other, the grading rules bar him from placing inferior lumber in with the upper grades.

Description of Grades.

C. and better.

Sound material free from knots, pitch seams, wane and sap-stain, and true to dimensions. May be all sap-wood, all heart-wood, or any combination of the two. Dimensions may be: thickness, 5/4", 6/4", 8/4" or 12/4"; width, anything over 8". A very small amount of 5/4", 8/4" and 12/4" stock was sawed. Fully 85 per cent of the stock was sawed 6/4".

D. Select and better.

Sound material free from sap-stain, large pitch seams and wane, true to dimensions, occasional pin-knots allowed. Can be all heart-wood, all sap-wood, or any combination of the two. Dimensions may be: thickness, 1"; width, no restrictions.

Moulding stock.

Sound material, free from knots and sap-stain. Wane on one edge allowed. Must be all sap-wood. Edgings, except from shims, containing clear, sound sap-wood, free from stain, and of sufficient width are graded as moulding stock. Dimensions may be 5/4", 6/4" or 8/4"; width, 8" or below. Most of the moulding stock graded consisted of edgings from 6/4" C. and better and shop material.

No. 1 Shop.

Sound material, free from sap-stain, and true to dimensions, which can not be graded as C. and better, due to the presence of knots, pitch-seams and wane. The knots may be large, small, or of various sizes, or may be sound or decayed without affecting the grade so long as the material shows at least 75 per cent of clear cuttings. Dimensions may be: thickness, 5/4", 6/4" or 8/4"; width, 8" or over; 6/4" material usually sawed.

No. 2 Shop.

Sound material, free from sap-stain and true to dimensions, which can not pass as No. 1 Shop but which must contain at least 50 per cent of clear cuttings. Dimensions the same as for No. 1 Shop; 6/4" material usually sawed.

No. 3 Shop.

Sound material, free from sap-stain and true to dimensions, which can not pass as No. 2 Shop, but which must contain at least 25 per cent of clear cuttings. Dimensions the same as for No. 1 and No. 2 Shop; 6/4" material usually sawed.

Box.

Sound material, true dimensions, less than 12" in width, which can not pass as No. 3 Shop, due to the presence of numerous knots, sap-stain or excessive wane. Dimensions may be: thickness, 1", 5/4", 6/4" or 8/4"; width, under 12".

Shop 1".

Sound material 1" thick, free from sap-stain and true to dimensions. Grade about the same as No. 2 Shop. Dimensions may be: thickness, 1"; width, 8" or over.

No. 1 Common.

Sound material 12" or more in width, free from sap-stain and wane, and true to dimensions, which can not be graded as No. 1 Shop, due to numerous small, sound knots. This grade of material must be springy, heavy, and have all indications of fair strength. Dimensions may be: thickness, 1" or 8/4"; width, 12" or over; 1" x 12" material usually sawed.

No. 2 Common.

Sound material 12″ or more in width, free from sap-stain and wane, and true to dimensions, which can not be graded as No. 1 Common due to large, sound knots being present. This grade of material must also show fair indications of strength. Dimensions the same as No. 1 Common.

No. 3 Common.

Sound material 12″ or more in width, free from sap-stain and wane and true to dimensions. This material is barred from No. 1 and No. 2 Common since it is light in weight and lacks the necessary springiness indicative of strength. Dimensions the same as for No. 1 and No. 2 Common.

Shims.

Sound material not true to dimensions. Poorly sawed lumber, thin in some places and thick in others. This grade includes lumber from all other grades except Culls. It was observed that shims, as a rule, were high grade material, cut from the outside of fair-sized logs. The sawyer apparently had better control of the sawing after the log had been squared. Shims may be of various sizes; dimensions not definite.

2″ x 4″ and wider.

Sound material 2″ thick and at least 4″ wide, true to dimensions and containing many small knots. Quality about the same as Box, No. 2 Common or No. 3 Common.

4″ x 4″ and larger.

Sound material 4″ thick and 4″ wide or larger, true to dimensions. Quality about the same as Box, No. 2 Common or No. 3 Common.

Plank 3″.

Sound material sawed 3″ thick and of various widths, true to dimensions and containing many small knots. Quality about the same as Box, No. 2 Common or No. 3 Common. Note: Some 3″ plank was sawed from the sap-wood of large logs and passed the grade of C. and better.

Culls.

Unsound material, and material containing many large, rotten knots or excessively cross-grained. In short, any lumber sawed which contains defects sufficient to bar it from all of the other grades. Dimensions: all sizes of stock sawed.

UTILIZATION.

At the time this study was made there could not have been a much closer utilization of forest products than that practiced by the Red River Lumber Company. The woods operations being very close to the mill made the cost of logging exceptionally low, thus making it profitable to handle logs of exceedingly low grade. If a log from a windfall was believed to contain 10 per cent sound material, it was sent to the mill, and logs from the tops of immature trees measuring not over four or five inches in diameter inside bark were also milled. The stumps of all trees were cut very low. The company's orders to its falling crews in this regard were to cut all stumps under eighteen inches in height, measuring from the ground to the saw cut. A very small per cent of the merchantable volume was lost, due to breakage in falling, since the land upon which the trees grew was exceptionally level, also since broken sections measuring only seven or eight feet in length were used.

It probably would have been next to impossible to have sawed more lumber from the logs after they reached the mill than was sawed by this company. The slabs were cut as thin as possible, and short lengths were sawed where the taper was great enough to permit it. Edgings of clear straight grained material were utilized and graded as moulding stock, and in a great many cases considerable wane was left on the end of boards coming from the small end of logs.

The milling machinery was of modern type throughout. Therefore, the minimum amount of waste in the form of sawdust resulted, and, lastly, some of the lumber manufactured was cut shy on dimensions.

The above facts account for the enormous mill over-run based on the Spaulding Log Rule, which averaged for all lumber cut each month between 35 and 40 per cent.

F. O. B. PRICES.

The following F. O. B. prices for the various grades of lumber sawed at the Red River Lumber Company's mill were in vogue during the fall of 1913 and winter of 1914, and were used in this report for all value determinations:

	Per 1,000 board feet
C. and better, 6/4"	$32 00
D. Select and better, 1"	25 00
Moulding stock	30 00
No. 1 Shop, 6/4"	27 00
No. 2 Shop, 6/4"	18 00
No. 3 Shop, 6/4"	13 00
Box 6/4"	11 00
Box 1"	9 00
Shop 1"	18 00
No. 1 Common	22 00
No. 2 Common	18 00
No. 3 Common	15 00
Shims	7 00
2" x 4" and wider	15 00
4" x 4" and larger	15 00
Plank 3"	15 00
Culls	7 00

PART II. GRAPHIC ANALYSIS.

Part II of this publication is a detailed graphic analysis of all the woods and mill data pertaining to the volume, value and growth of immature and mature western yellow pine; resulting from field work described in Part I.

The methods of graphic analysis afford, without doubt, the most authentic means of determining the underlying principles and average values from a large amount of data. Average values obtained by such methods depend not only upon the arithmetical averages of the parts which make up the whole, but each part in turn depends upon every other part. Values and underlying principles determined by graphics from a large number of observations are dependent upon the majority of observations made, and are not influenced to any great extent by erratic values, which are usually the result of some error in observation. Such errors as a rule are compensative, and the principal tendency they have is to enlarge the field of variation. They do not affect the curve of averages such as would be located by one of skill and experience.

Compensative errors may occur in large numbers without any influence upon the final results. They may, however, make the work more difficult and obscure, but so long as they are well within the minority their influence should never reach the skilfully located locus of averages.

Accumulative errors have an entirely different effect. Their influence can not be eliminated from the final determinations unless a proper correction based upon the known errors be applied. Their effect will be to either raise or lower the curve of averages with an accompanying change of its slope. Such errors are introduced usually by using incorrect measuring instruments, such as a scale with divisions marked inches and tenths of inches which are a little greater or a little less than inches or tenths of inches, or by using incorrectly adjusted calipers, etc. Such errors are easily prevented by standardizing all instruments and scales before putting them into use, and then keeping them in good condition.

Still another form of error may creep in which is neither compensative nor accumulative, but which holds constant for each individual observation. This form also can not be eradicated by methods of graphics, unless known and the proper correction applied. It may be caused by measuring from a point on a tape which is not a true zero point, or by using a tape which has been spliced, such that beyond the splice it is longer or shorter than it should be. The effect upon the curve of averages is to raise or lower it by a constant amount without changing the slope. It is an error which should never enter into carefully performed work.

Notwithstanding the great advantages of graphics, it is a very poor method for an inexperienced person to use, since many inconsistencies may result. For instance, it is very possible to establish a set of values which absolutely contradict another set, and both sets be based upon the same original data. This may result from changing from one variable as the basis of comparison to another.

In the following graphic analysis, which embodies all data pertaining to this study, the variable chosen as the dependent variable is diameter breasthigh in inches. With but one exception (age-identification relations, which are based on age) it has been used throughout as the basis of comparison, and a complete analysis based upon it has been made for whole trees, butt logs and top logs, with the object in view to show both quantity and quality of the whole trees, of the butt logs, or best part of the tree, and of the top logs, the poorest part of the tree.

The complete data for each individual tree, as shown in Plates II to X were first assembled, each tree having a woods sheet, a stem analysis sheet, and as many mill sheets as there were logs in the tree. These assembled data, representing nine hundred and nineteen trees in all, were then divided, according to the identification made in the woods into two groups; typical yellow pine forming the one, which proved to be mature yellow pine; and bull pine or blackjack, which proved to be immature yellow pine, forming the other. There was a total of five hundred and seven immature, and four hundred and twelve mature trees. A complete analysis was made separately of each group, and the results have been averaged by means of curves and arranged on opposite pages of this publication so that a comparison might be easily followed. The trees of each group were arranged in classes, according to diameter breasthigh measurements, such that all trees ranging from 19″ to 20.9″, inclusive, formed the 20″ diameter class, and all trees ranging from 21.0″ to 22.9″, inclusive, formed the 22″ diameter class, and so on. Corresponding determinations of each diameter class were then added together and the arithmetical averages obtained by dividing the sums in each case by the total number of trees in the class.

Butt logs and top logs from immature and mature trees were analyzed in a similar manner, and the results averaged and arranged on opposite pages the same as for whole trees.

The original determinations averaged for each diameter class were as follows:

Clear length.
Merchantable length.
Total height.
Diameter of last log used.
Thickness of bark.
Height of stump.
Age.
Total volume in cubic feet inside bark from stump to height where the tree is 6″ in diameter outside bark.
Total volume in board feet as shown by the Spaulding Log Rule.
Total volume in board feet actually "sawed out" at mill.
Total volume of each grade in board feet contained in each tree actually "sawed out" at mill.

The number of trees forming each diameter class for the immature were as follows:

20″ class	12 trees
22″ class	39 trees
24″ class	67 trees
26″ class	92 trees
28″ class	96 trees
30″ class	65 trees
32″ class	58 trees
34″ class	30 trees
36″ class	28 trees
38″ class	9 trees
40″ class	9 trees
42″ class	2 trees
Total	507 trees

For the mature as follows:

20″ class	6 trees
22″ class	9 trees
24″ class	16 trees
26″ class	33 trees
28″ class	41 trees
30″ class	33 trees
32″ class	53 trees
34″ class	66 trees
36″ class	48 trees
38″ class	44 trees
40″ class	28 trees
42″ class	20 trees
44″ class	11 trees
*46″ class	2 trees
*48″ class	1 tree
*50″ class	1 tree
Total	412 trees

Therefore all diagrams for immature yellow pine in this publication, showing a relation existing between diameter breasthigh and some other variable, are based upon average points plotted, from left to right, with weights: 12, 39, 67, 92, 96, 65, 58, 30, 28, 9, 9, and 2 trees, respectively.

In like manner, all diagrams for mature yellow pine are based upon average points plotted from left to right, with weights as follows: 6, 9, 16, 33, 41, 33, 53, 66, 48, 44, 28, 20, and 11 trees.

The following symbols have been used in connection with the diagrams constructed to indicate relations existing between the various determinations made.

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*Not used in the final analysis.

Let a = the average volume in board feet of $\frac{6}{4}''$ C. and Better lumber contained in an immature tree D inches in diameter breasthigh.

Similarly, let b = Moulding Stock.
c = No. 1 Shop, $\frac{6}{4}''$.
d = D. Select and Better, 1″.
e = No. 1 Common, 1″.
f = No. 2 Common, 1″.
g = Shop, 1″.
h = No. 2 Shop, $\frac{6}{4}''$.
i = Shims.
j = Box, 1″.
k = Culls.
l = Box $\frac{6}{4}''$.
m = No. 3 Shop, $\frac{6}{4}''$.
n = No. 3 Common, 1″.
o = Plank 3″.
p = 4″ x 4″ and larger.
q = 2″ x 4″ and wider, No. 1 Dim.
D = Total volume in cubic feet inside bark from the stump to a height where the tree is 6″ in diameter outside the bark.
As = Total volume in board feet, as shown by the Spaulding Log Rule.
A = Total volume in board feet of lumber of all grades "sawed out" at mill.
Av = Volume of high grade lumber.
Bv = Volume of intermediate grade lumber.
Cv = Volume of low grade lumber.

Then $a + b + c + \text{-------} \; o + p + q = A$, total volume in board feet sawed out at mill.

$a + b + c + d = Av$, high grade.
$e + f + g + h + i = Bv$, intermediate grade.
$j + k + l + m + n + o + p + q = Cv$, low grade.
$Av + Bv + Cv = A$.

$$\frac{100\,(a + b + c + d)}{A} = \frac{100\,Av}{A} = Ap,$$ per cent of high grade lumber sawed out.

$$\frac{100\,(e + f + g + h + i)}{A} = \frac{100\,Bv}{A} = Bp,$$ per cent of intermediate grade lumber sawed out.

$$\frac{100\,(j + k + l + m + n + o + p + q)}{A} = \frac{100\,Cv}{A} = Cp,$$ per cent of low grade lumber sawed out.

$$Ap + Bp + Cp = 100\%.$$

$$.032a + .030b + .027c + .025d = Aval,$$ value in dollars and cents of Av, the high grade lumber produced.

$.022e + .018f + .018g + .018h + .007i = Bval$, value in dollars and cents of Bv, the intermediate grade lumber produced.

$.009j + .011k + \text{---------} .015q = Cval$, value in dollars and cents of Cv, the low grade lumber produced.

$Aval + Bval + Cval = B$, value in dollars and cents per tree.

$\frac{1000\,B}{A} = C$, value per 1000 board feet per tree.

The above symbols are also used with a subscript "1" attached to indicate similar relations for mature trees; with a subscript "1" and prime attached, to indicate similar relations for butt logs of mature trees; with a subscript "1" and a double prime attached, to indicate similar relations for top logs from mature trees. To illustrate:

a stands for the average volume in board feet of C and Better lumber contained in an immature tree D inches in diameter breasthigh.

a' stands for the average volume in board feet of C and Better lumber contained in a 16′ butt log from an immature tree D inches in diameter breasthigh.

a'' stands for the average volume in board feet of C and Better lumber contained in the last log used from an immature tree D inches in diameter breasthigh.

a_1, a_1', and a_1'' stand for similar relations for mature yellow pine.

Symbols appear in lower right-hand corner of each diagram.

FOR WHOLE TREES.

Age—Identification Relations.

Trees increase in diameter and height as they become older, and the rate of increase is dependent upon a great many influencing factors not always apparent to the closest observer. Trees of the same species may have a wide range in rate of growth, such that the age can not be judged by their size. It may be that the smallest tree in a group ranging in size from twenty to forty inches in diameter breasthigh is the oldest of that group, and the forty-inch tree the youngest. Some yellow pine trees measuring over forty inches in diameter have proved to be less than two hundred years old, whereas age determinations have shown trees of half that diameter to be over four hundred years of age.

The outward appearances of such trees are, however, very different. The large ones which may be comparatively young have a dark, thick, rough bark, numerous small limbs extending well down into the middle third and a cone-shaped top, whereas the small ones, which may be about twice as old, have a light colored rather thin, smooth bark, furrowed longitudinally and horizontally, forming plates which are comparatively smooth. All live limbs are very large and usually all above the middle third. The top is generally dome-shaped.

The age of yellow pine trees, which have grown under conditions similar to those existing in Lassen County, can be determined from outward appearances much closer than from height and diameter measurements. Figs. 3 and 4 show that the immature trees merge into a stage where the outward appearances are as much like the mature as the immature, and finally into the ages where the characteristics of the immature tree have vanished. The change in life, as this may be termed, averages two hundred and sixty-five years.

In Forest Service Bulletin No. 125, page 20, it is shown that the maximum periodic annual growth of yellow pine is obtained at two hundred and sixty years. That is, up till this age they have an accelerated growth, and lay on more wood each year than the year previous. After two hundred and sixty years the growth is a retarded one, and the volume of wood formed each year is a decreasing factor.

It is interesting to note that the change in life occurs at two hundred and sixty-five years, which is about the same age that the prime of life is reached, as shown by a separate investigation.

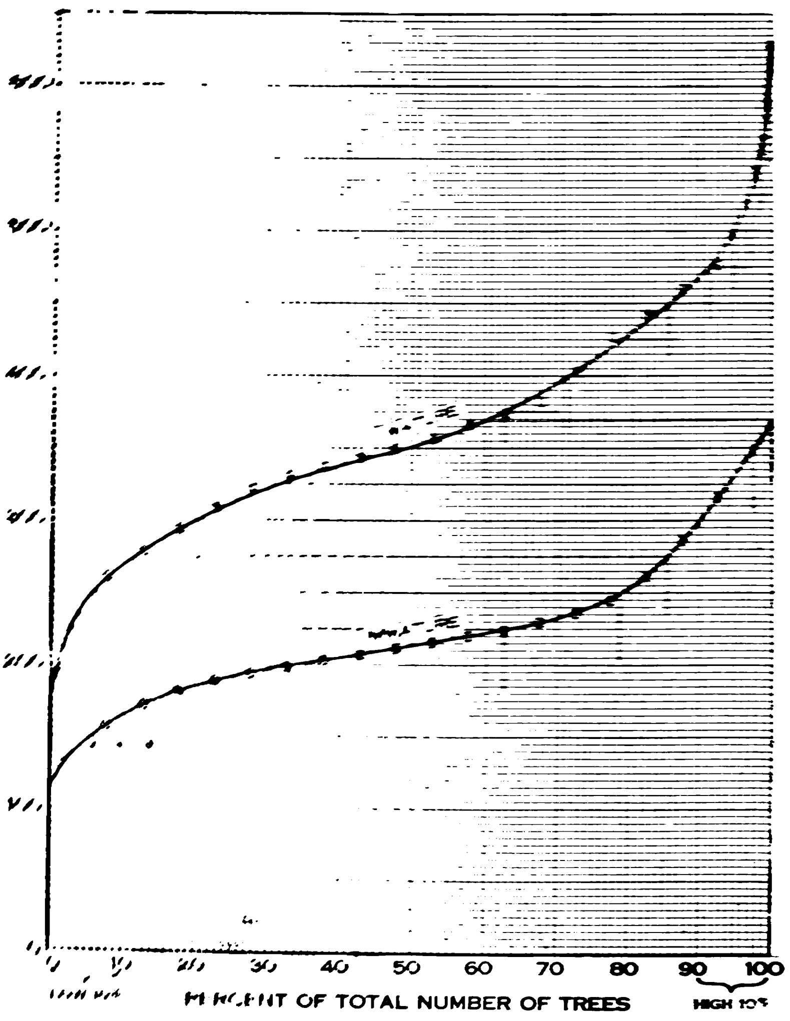

FIG. 1. The relation of age to outward appearances. The bottom curve marked "immature" is based upon [illegible] trees, which were identified as "bull pine" (or "black-[illegible]) [illegible]. This curve was constructed as follows: (a) Data sheets were arranged in order of age from the youngest to the oldest tree. (b) Sheets were then divided into groups, each representing five per cent of the total number of trees. (c) The average of each of these groups were then plotted in their respective order. (d) Individual trees were plotted for the lowest five per cent and also for the highest five per cent. The top curve marked "mature" is based upon 412 trees identified as typical yellow pine, and was constructed the same as the curve marked "immature."

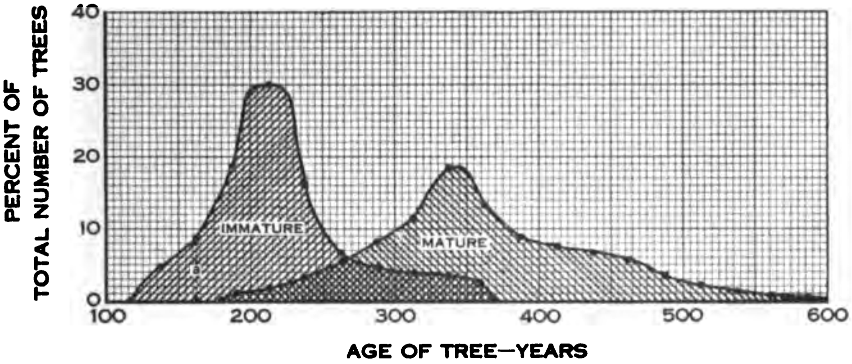

FIG. 2.—A diagram obtained directly from Fig. 1. The black points on the boundary show the per cent of total number of trees falling within periods of twenty-five years. For instance; the ordinate marked (*a*) indicates that nine per cent of all of the trees measured and identified as "bull pine" (immature) fell between 150 and 175 years. Ordinate (*a*) was plotted directly from Fig. 1, as indicated in that figure. All other ordinates were plotted in a similar manner.

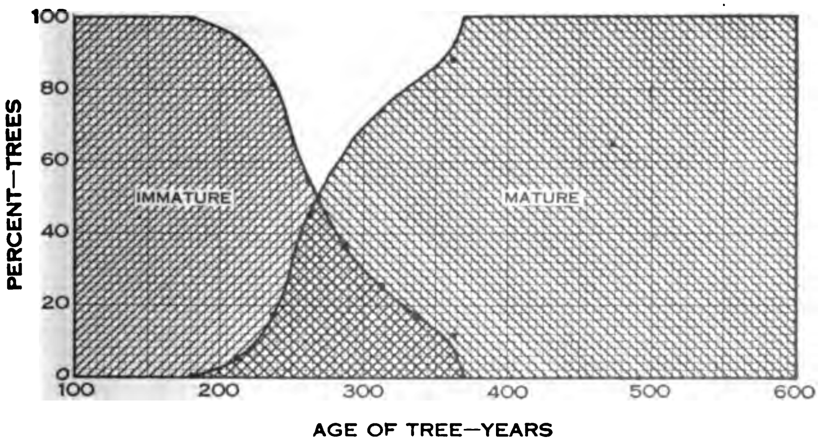

FIG. 3.—A diagram obtained directly from Fig. 2, and based upon the per cent of identifications of "bull pine" (immature) and typical yellow pine (mature), occurring at different ages. The lapping over of the two portions of the diagram indicates the ages at which maturity is reached; also, the per cent of total number of trees maturing at different ages.

Dimensions.

The following curves show the average dimensions of immature and mature trees of different diameters:

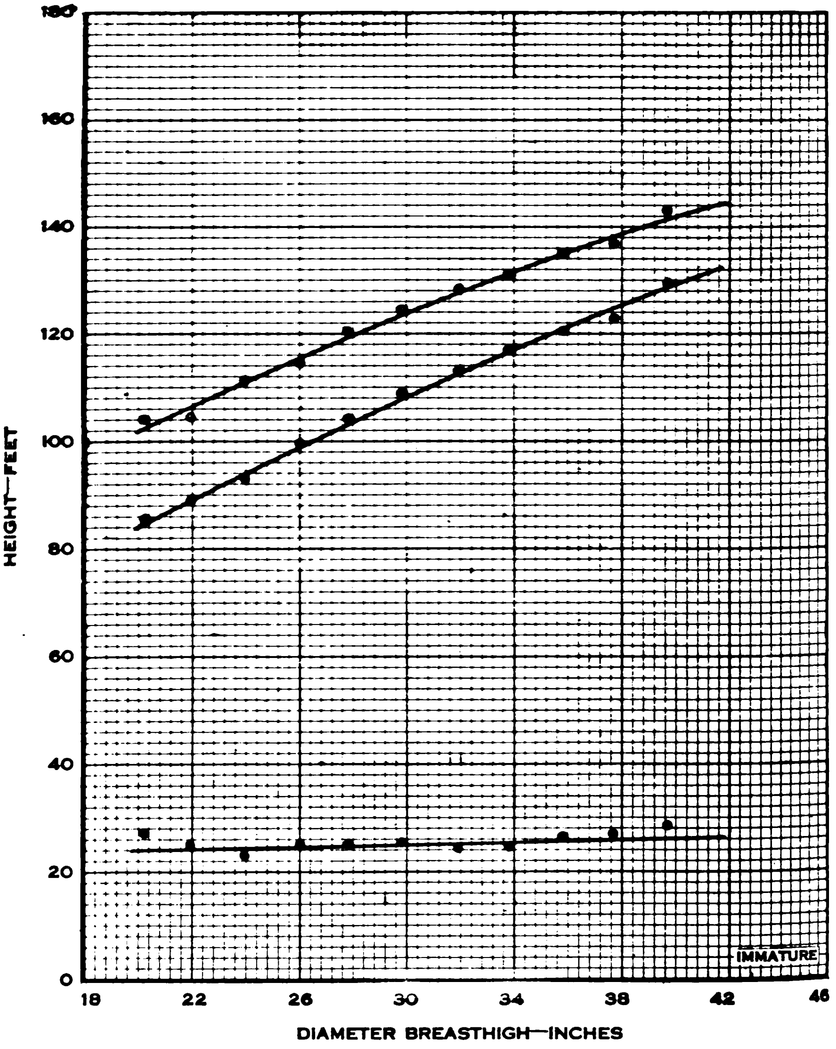

Fig. 4.—Curves showing average values for clear length, merchantable length, and total height, of immature western yellow pine trees, different diameters breasthigh.

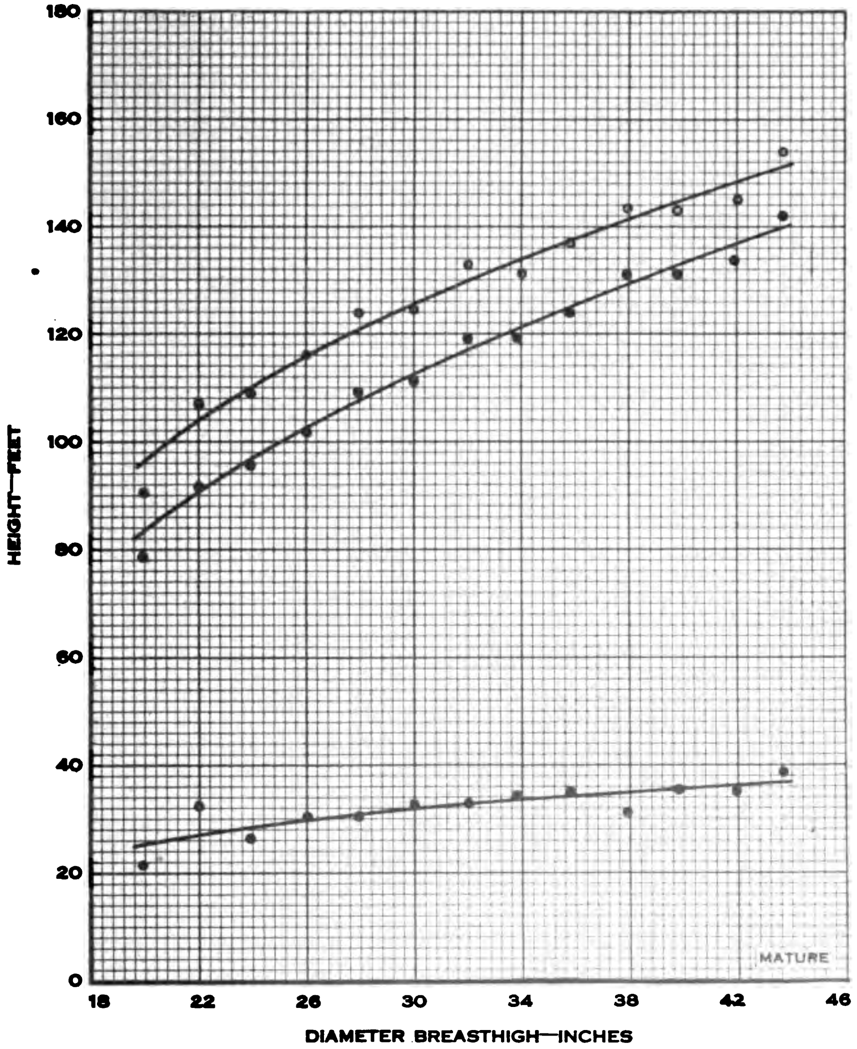

FIG. 5.—Curves showing average values for clear length, merchantable length, and total height, of mature western yellow pine trees of different diameters breasthigh.

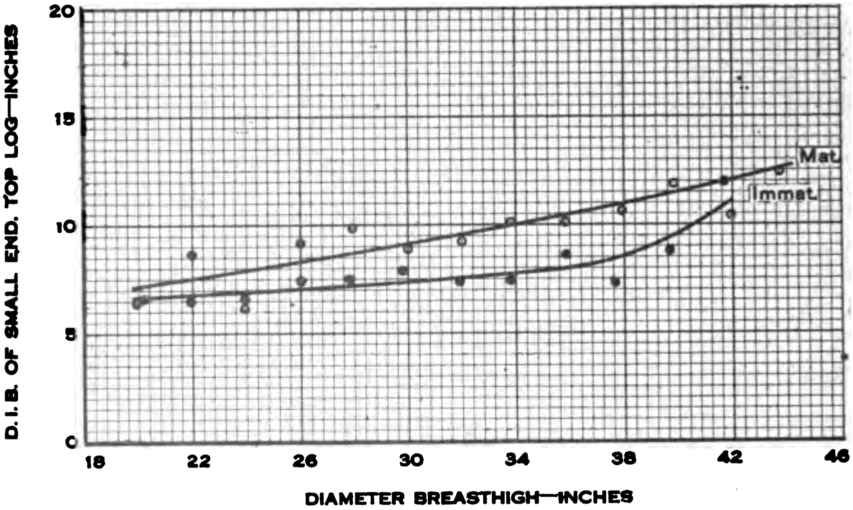

FIG. 6.—Curves showing average diameter inside bark at small end of last log used from immature and mature western yellow pine trees of different diameters breasthigh.

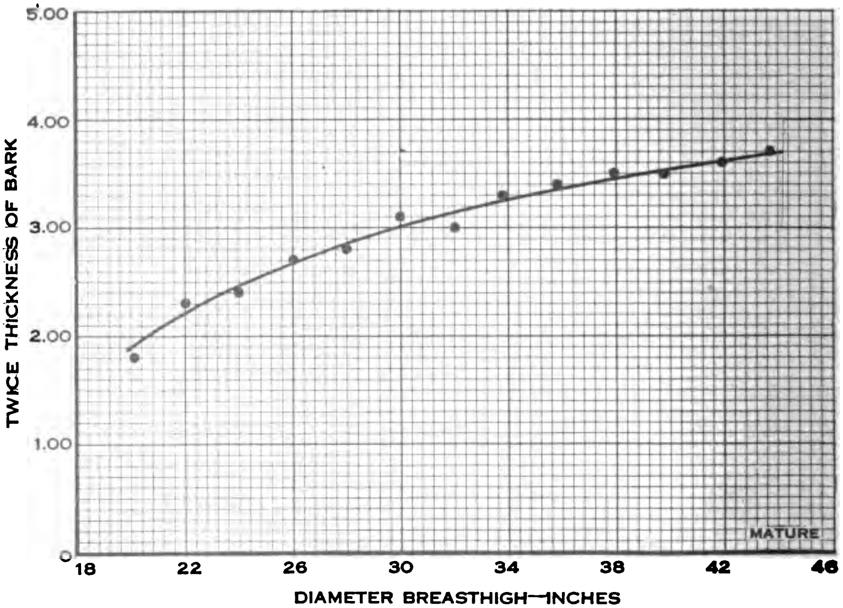

FIG. 7.—Curve showing average values for twice thickness of bark at the top of 16′ butt logs from mature western yellow pine trees of different diameters breasthigh.

Form.

By the "form" of a tree is meant the shape of the bole, or stem. Trees of the same species and of different diameters breasthigh necessarily do not have stems of the same shape. It may be that a large tree will have a very small taper in the lower third, a slightly greater one in the middle third and an exceedingly large taper in the top third. Or it may be that the taper will be rather uniform at all points along the stem. Trees with increasing taper, such as cited in the first case, have boles which approach very closely the shape of a paraboloid of revolution, where trees with a practically uniform taper approach more closely the shape of a cone. Young trees, as a rule, are of the latter form. Old trees are likely to be filled out more than the young, and therefore approach more closely the shape of a paraboloid.

Each layer of wood formed during the growth of a tree is not uniform in thickness at different heights from the ground. The wood of each annual layer as a rule is a little thicker in the top third of the stem than it is in the bottom third. This is very noticeable in trees which are nearing maturity. The annual layers formed by western yellow pine trees at this stage of life are a great deal thinner at the diameter breasthigh than in the top third of the bole. Such trees are "filling out"; their bark is also shedding faster than it is formed, and it is very possible for the diameter breasthigh measurement to hold constant or even decrease while the volume is gradually increasing. Fullness of bole or form is usually expressed in terms of "form factors."

Form factors.

A form factor for a given tree may be the volume of that tree in cubic feet divided by the volume of a cylinder, with dimensions equal to the breasthigh measurement and height of the tree. If the factor for a certain tree is .333, it means that the volume is equal to one-third of the cylinder to which the tree is compared. If the factor is .500, the tree has half the volume of the cylinder, and so on.

Tables 11 and 12, page 138, show form factors for the merchantable portions of both immature and mature yellow pine trees. It will be observed that the factors worked out for immature trees are larger for the small trees than for the large ones. This is due to the effect of "butt swelling." Since for small trees the breasthigh measurement, which is taken at four and one-half feet above the ground in all cases, is well above the enlarged portion of the butt. In large trees the effect of "butt swelling" enters in quite noticeably, thus giving a large breasthigh measurement and therefore larger cylinder for comparison. This reduces the form factor. It will be seen in Table 12, page 139, that the form factors for mature trees of different sizes are practically constant, and that the values in all cases are greater than for the immature, which shows that the former are filled out more than the latter and therefore contain more wood for a given diameter measurement.

[illegible]

Curves showing average values of total volume in board feet, also in cubic feet, contained in merchantable portion of [illegible] western yellow pine trees of different diameters breasthigh.

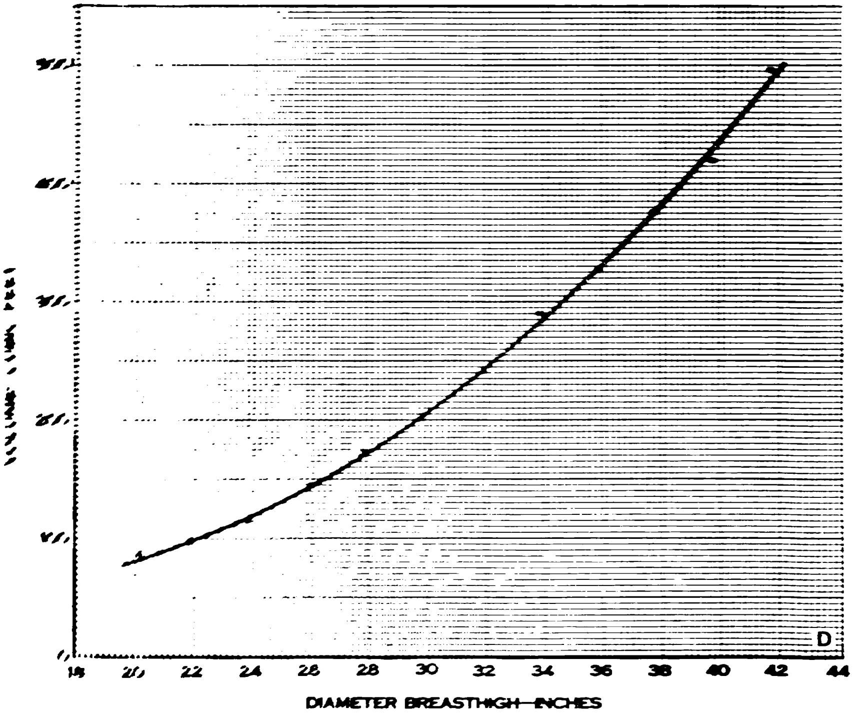

Fig. [illegible]. Total volume in cubic feet inside bark from the stump to a height where the tree is 6" in diameter outside the bark.

Curves showing average values for total volume in board feet, also in cubic feet, contained in merchantable portion of mature western yellow pine trees of different diameters breasthigh.

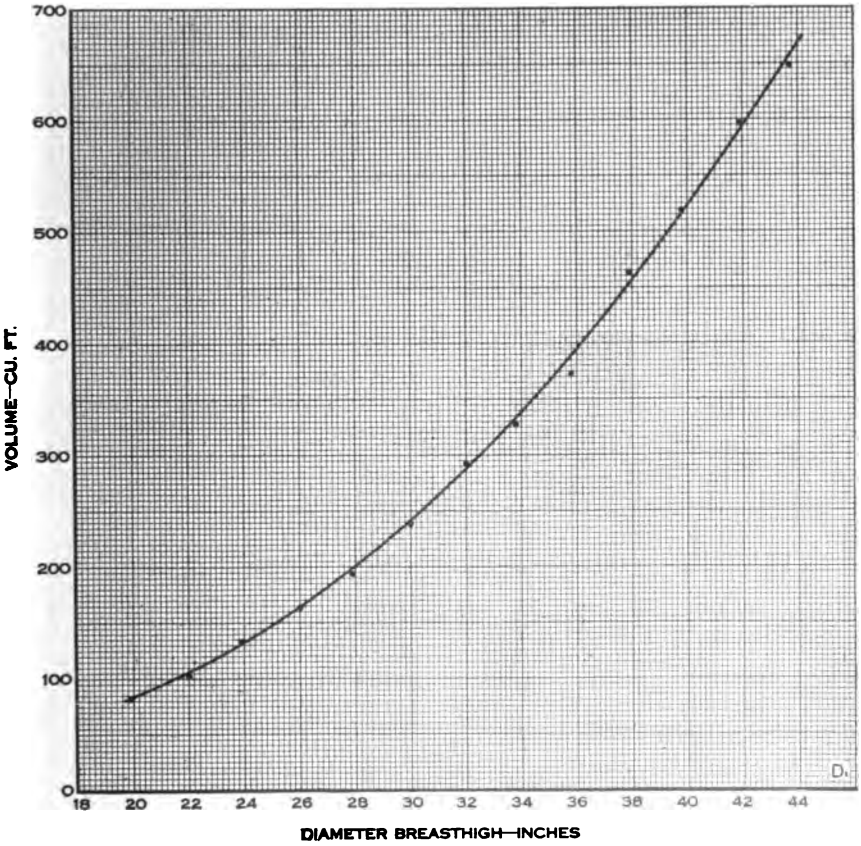

FIG. 9.—Total volume in cubic feet inside bark from the stump to a height where the tree is 6″ in diameter outside the bark.

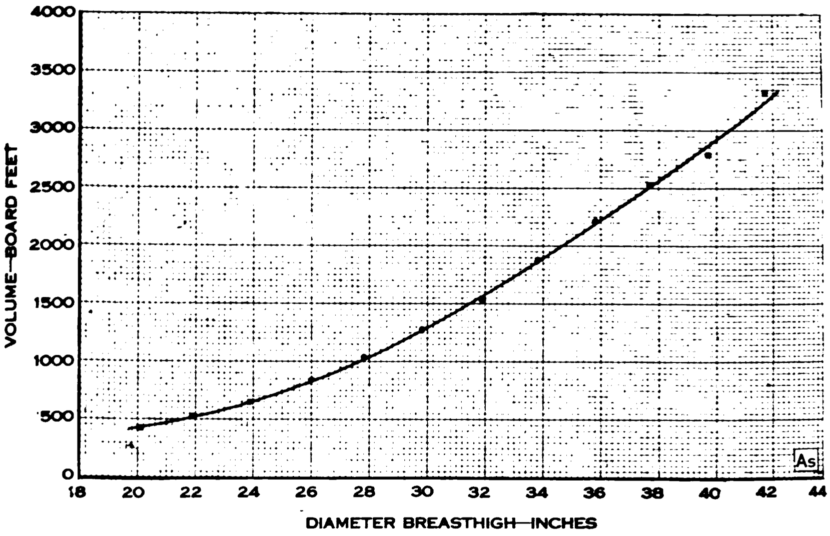

FIG. 10.—Total volume in board feet, as shown by the Spaulding Log Rule.

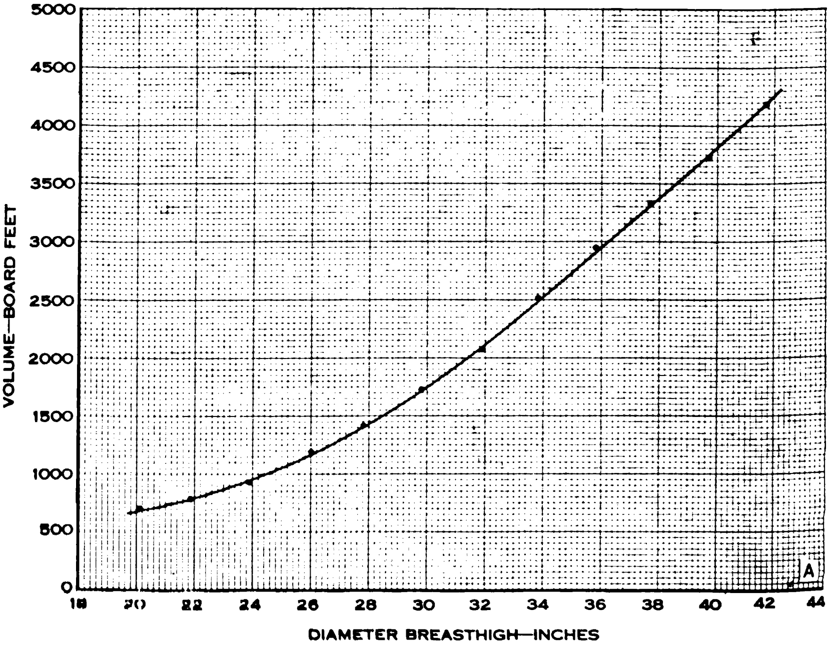

FIG. 11.—Total volume in board feet actually "sawed out" at mill.

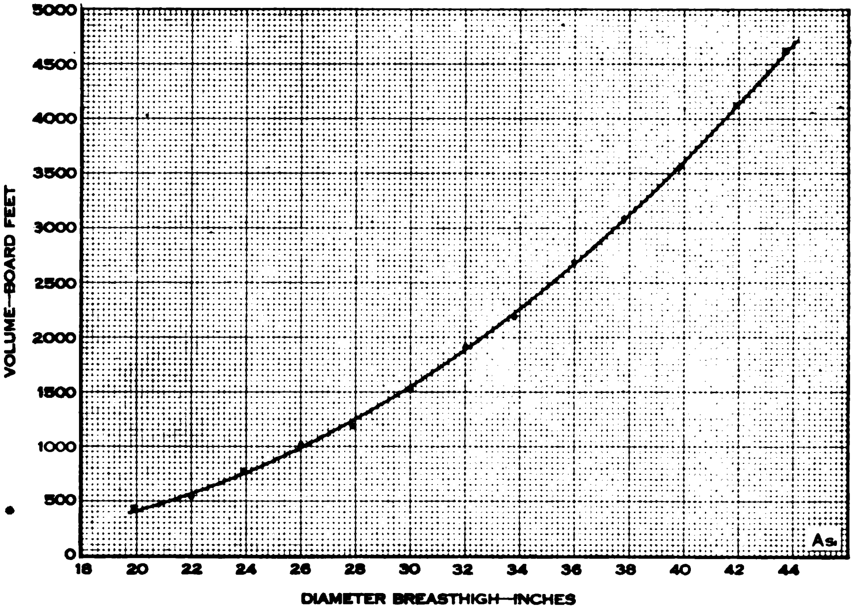

FIG. 12.—Total volume in board feet, as shown by the Spaulding Log Rule.

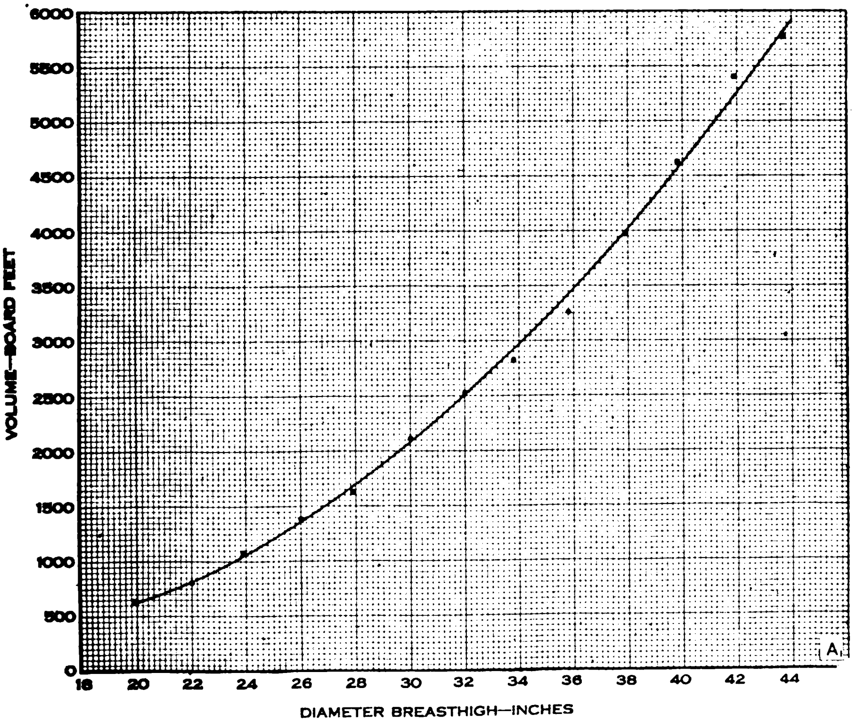

FIG. 13.—Total volume in board feet actually "sawed out" at mill.

Curves showing average volume in board feet of each grade actually "sawed out" at mill, from merchantable portion of immature western yellow pine trees of different diameters breasthigh.

High Grades Sawed From Immature Trees.

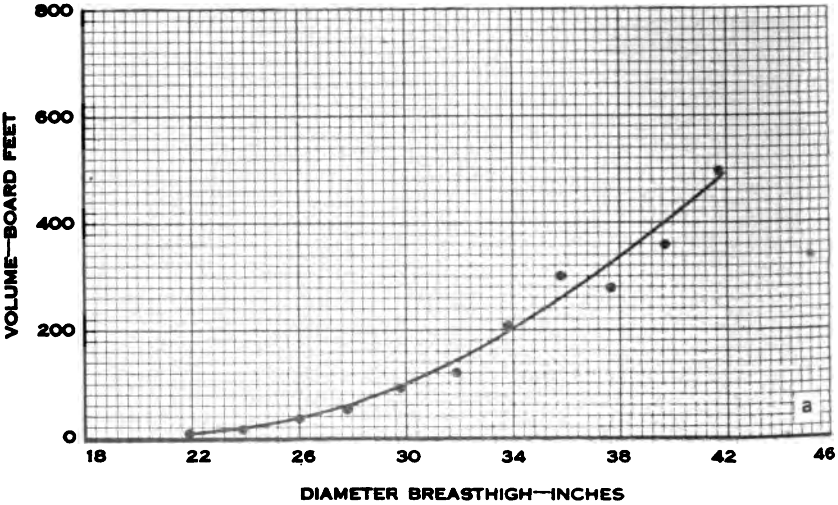

FIG. 14.—C. and Better, 6/4".

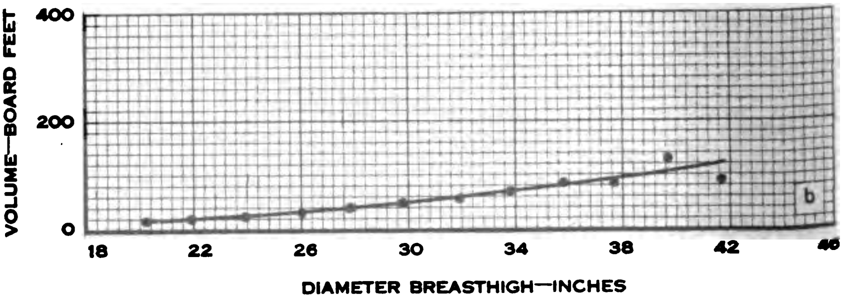

FIG. 15.—Moulding stock.

Curves showing average volume in board feet of each grade actually "sawed out" at mill, from merchantable portion of mature western yellow pine trees of different diameters breasthigh.

High Grades Sawed From Mature Trees.

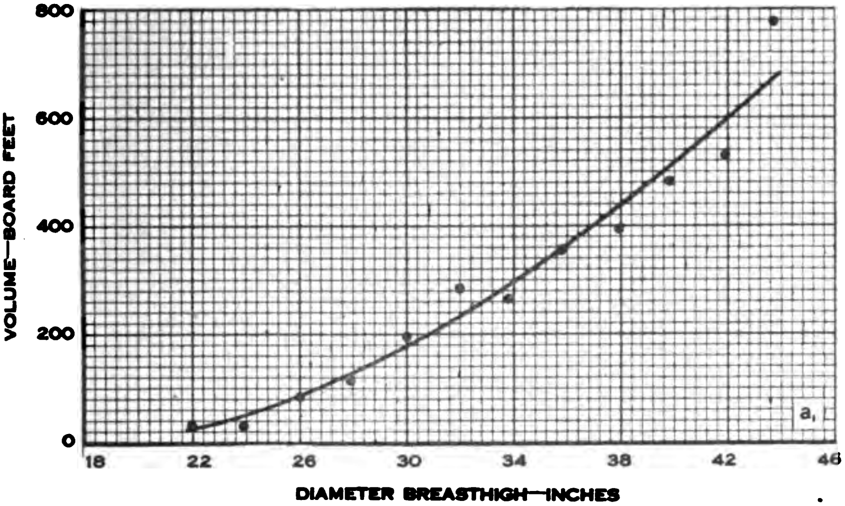

FIG. 16.—C. and Better, 6/4"

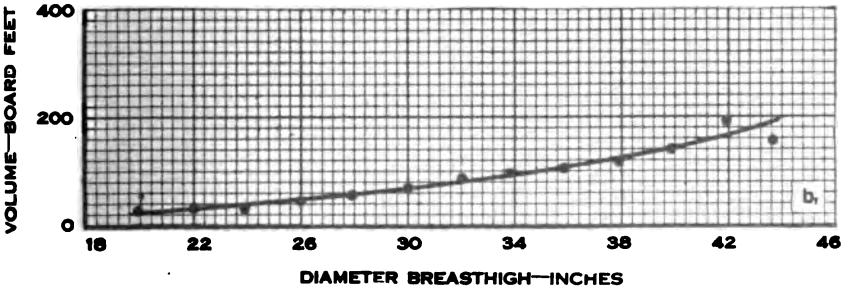

FIG. 17.—Moulding stock.

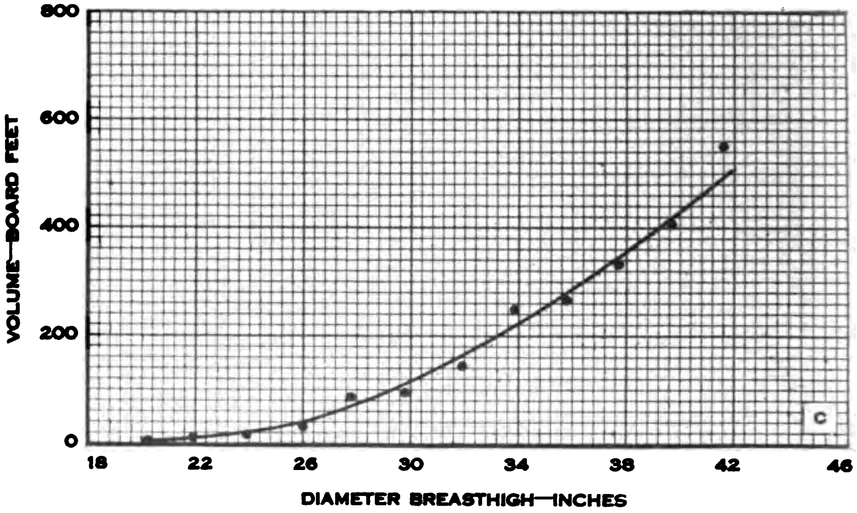

FIG. 18.—No. 1 Shop, 6/4".

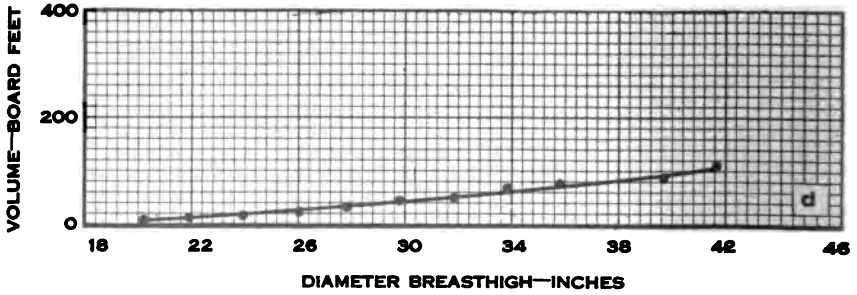

FIG. 19.—D. Select and Better, 1".

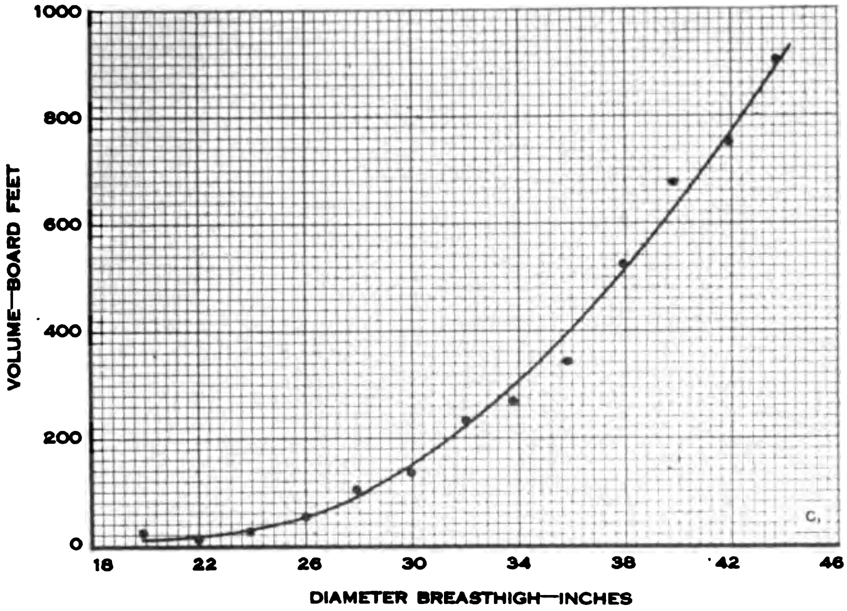

FIG. 20.—No. 1 Shop, 6/4".

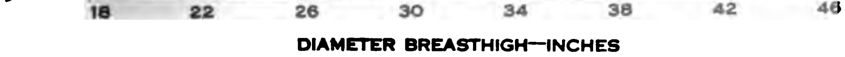

FIG. 21.—D. Select and Better, 1".

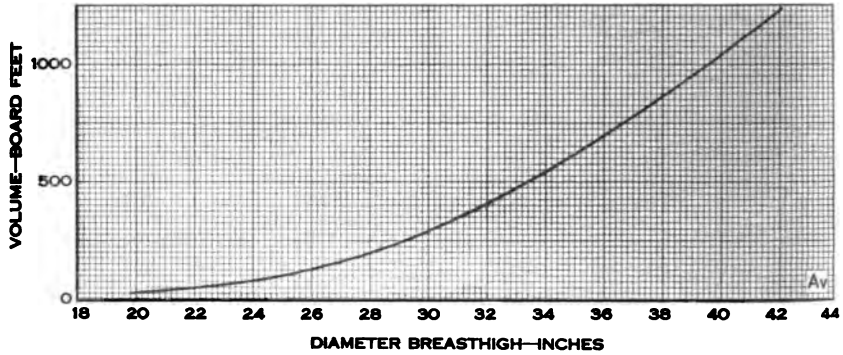

FIG. 22.—Total of high grades sawed from immature trees.

$$a + b + c + d = Av.$$

Intermediate Grades Sawed From Immature Trees.

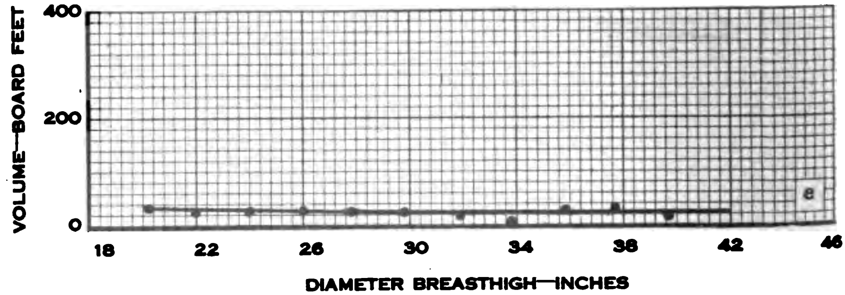

FIG. 23.—No. 1 Common, 1″.

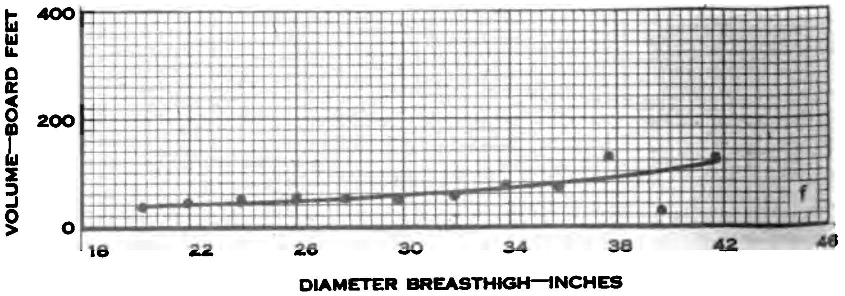

FIG. 24.—No. 2 Common, 1″.

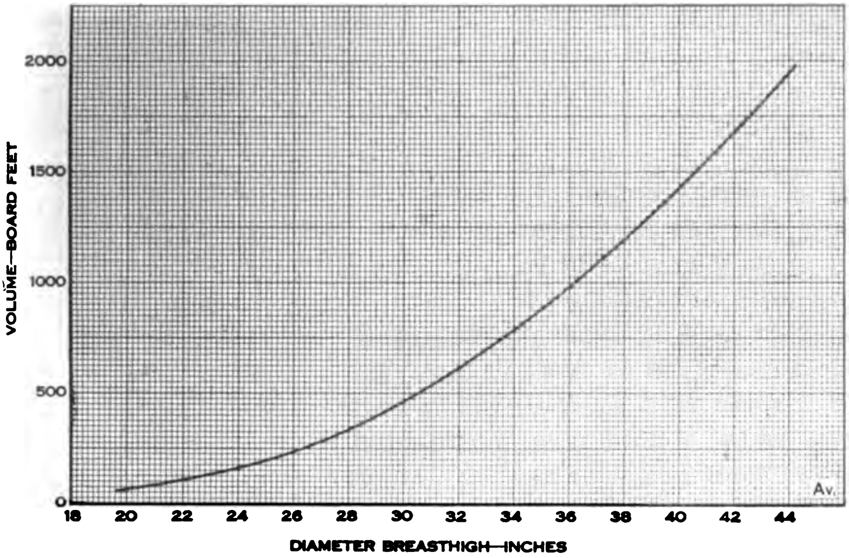

FIG. 25.—Total of high grades sawed from mature trees.

$$a_1 + b_1 + c_1 + d_1 = Av_1.$$

Intermediate Grades Sawed From Mature Trees.

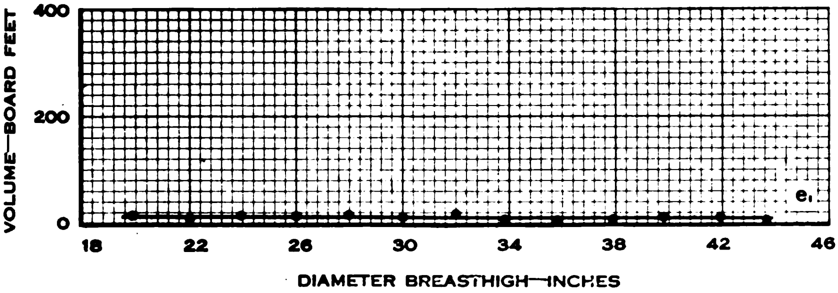

FIG. 26.—No. 1 Common, 1″.

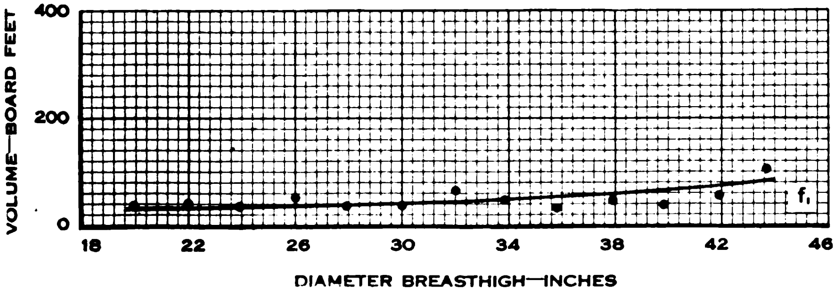

FIG. 27.—No. 2 Common, 1″.

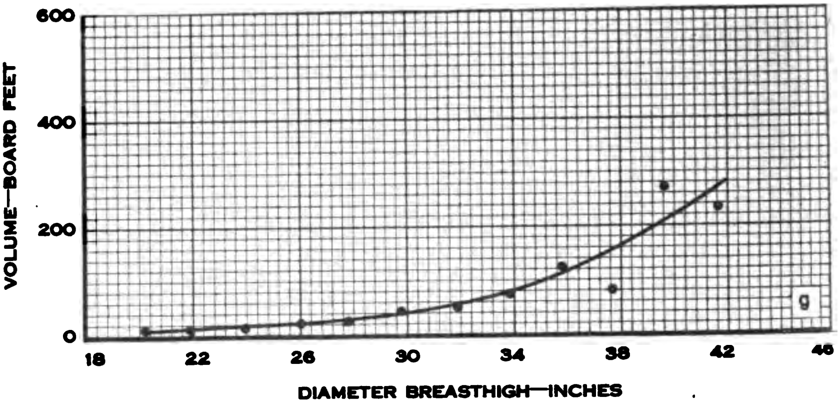

FIG. 28.—Shop 1".

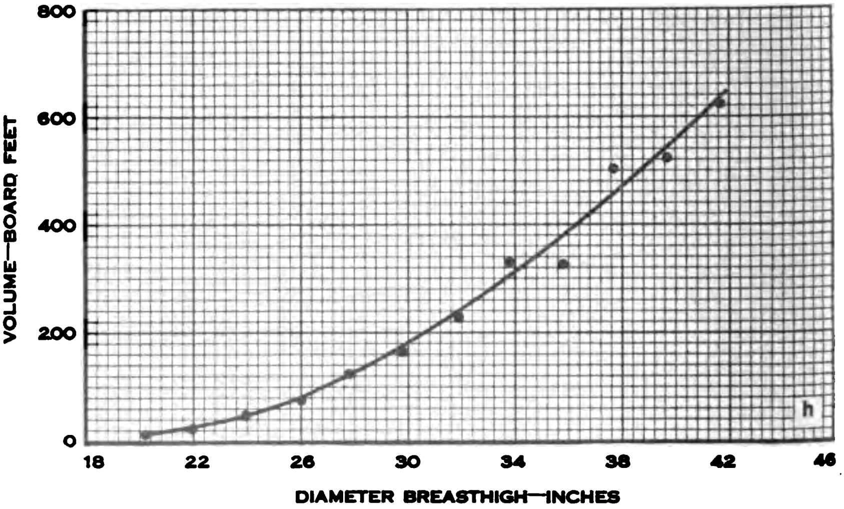

FIG. 29.—No. 2 Shop, 6/4".

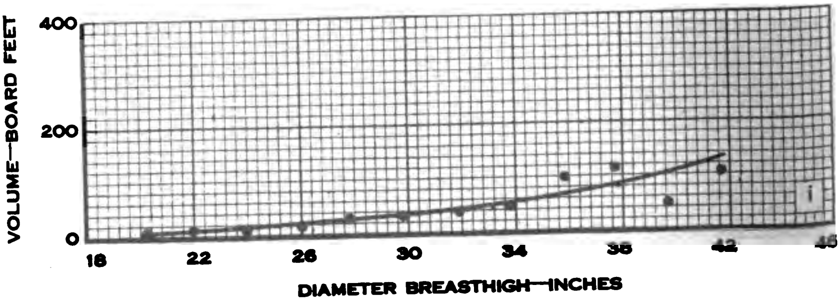

FIG. 30.—Shims.

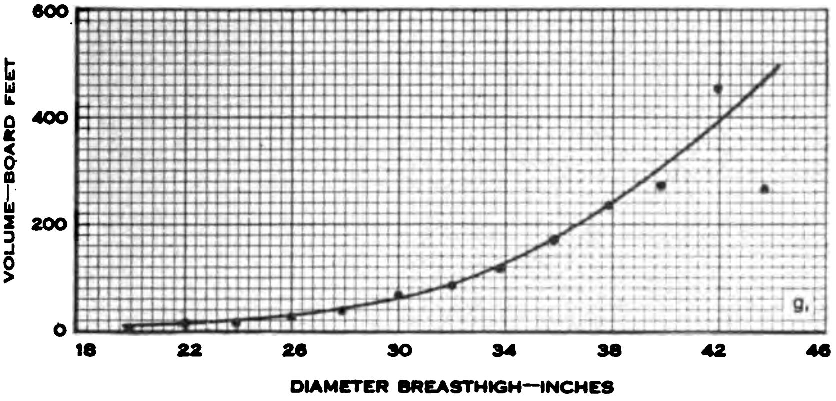

FIG. 31.—Shop 1".

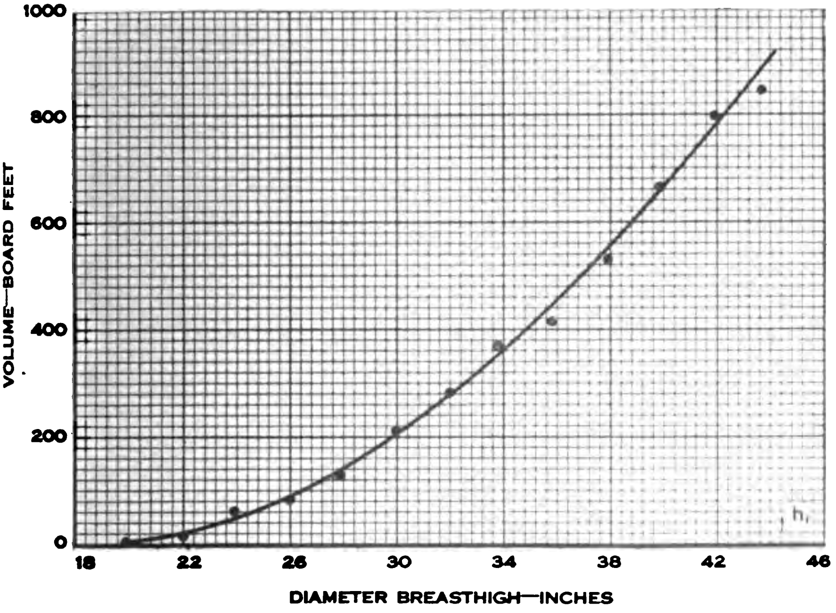

FIG. 32.—No. 2 Shop, 6/4".

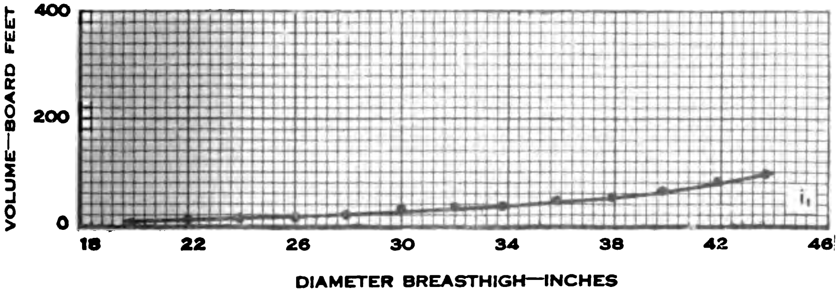

FIG. 33.—Shims.

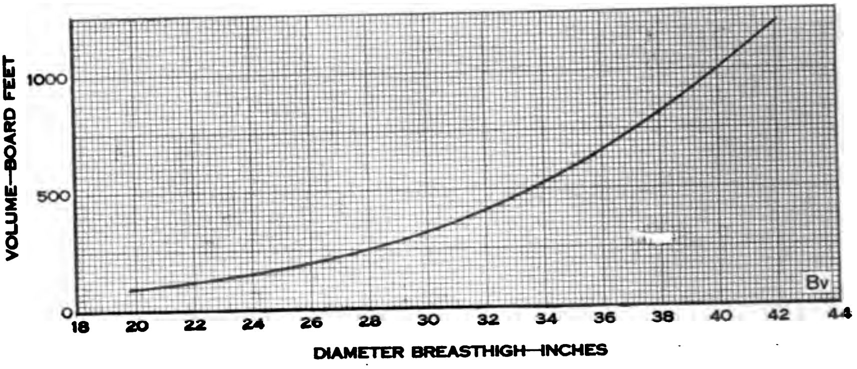

Fig. 34.—Total of intermediate grades sawed from immature trees.

$$e + f + g + h + i = Bv.$$

Low Grades Sawed From Immature Trees.

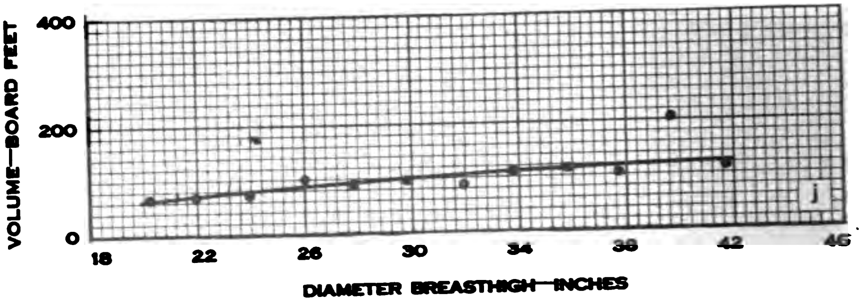

Fig. 35.—Box 1".

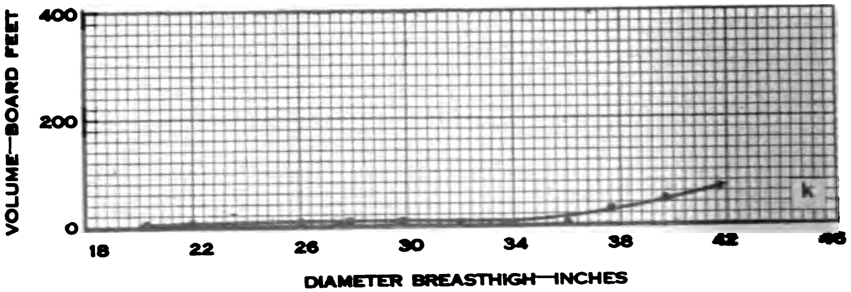

Fig. 36.—Culls.

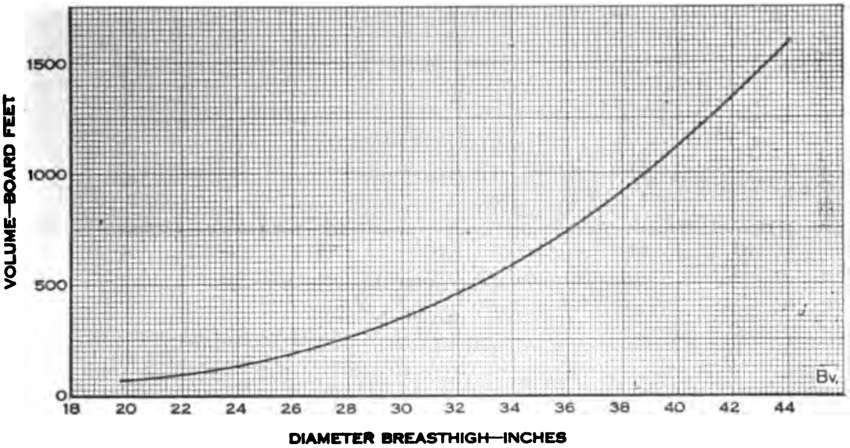

FIG. 37.—Total of intermediate grades sawed from mature trees.

$$e_1 + f_1 + g_1 + h_1 + i_1 = Bv_1.$$

Low Grades Sawed From Mature Trees.

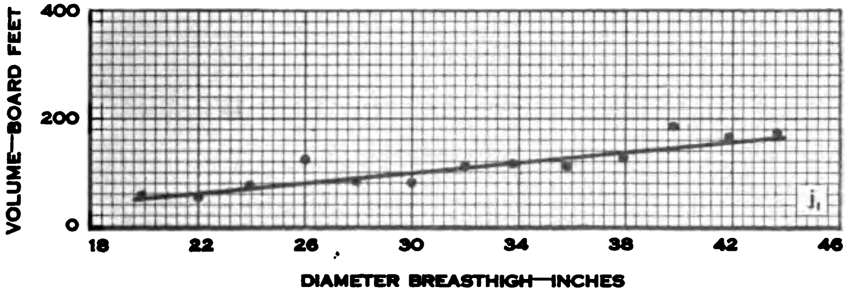

FIG. 38.—Box 1″.

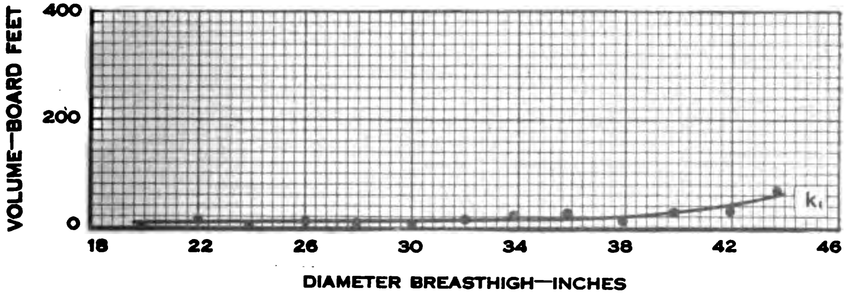

FIG. 39.—Culls.

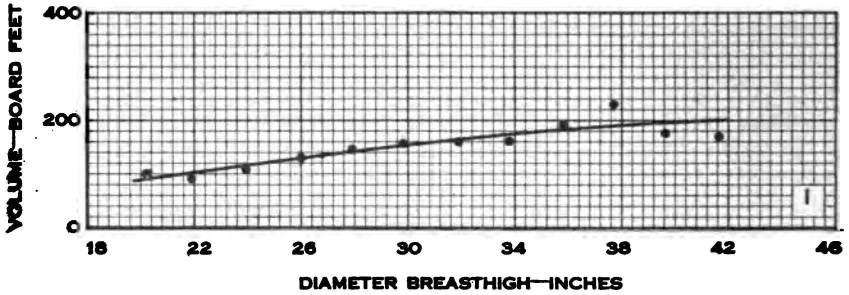

FIG. 40.—Box, 6/4".

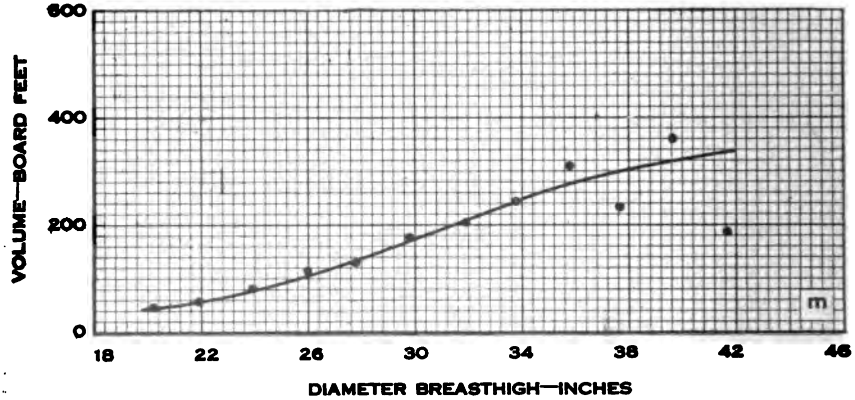

FIG. 41.—No. 3 Shop, 6/4".

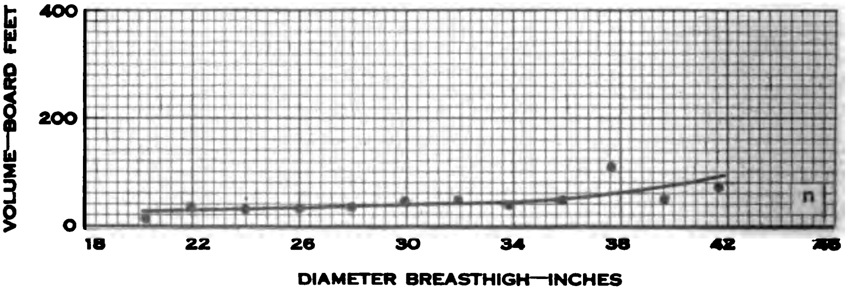

FIG. 42.—No. 3 Common, 1".

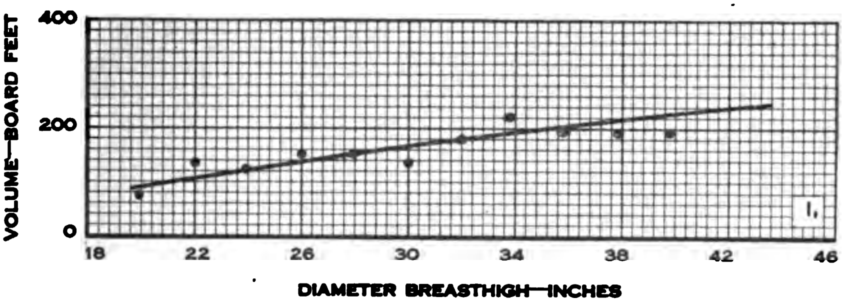

Fig. 43.—Box, 6/4″.

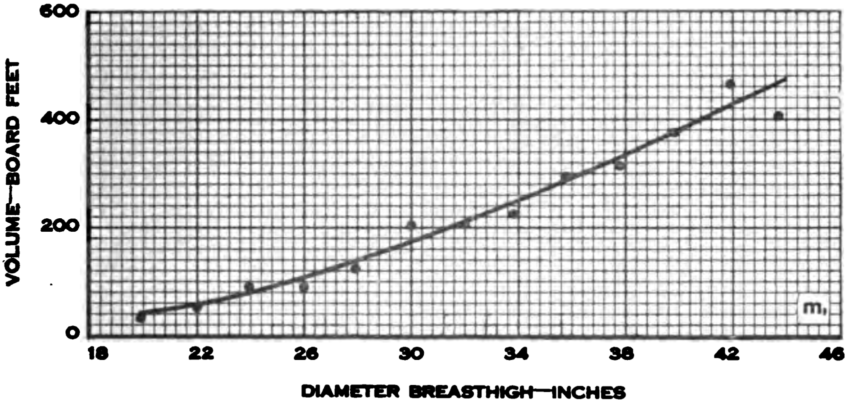

Fig. 44.—No. 3 Shop, 6/4″.

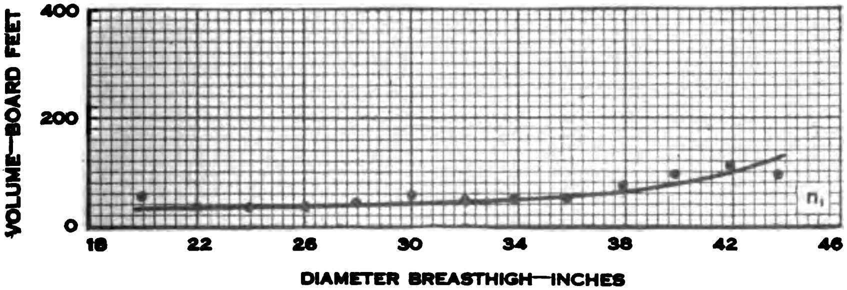

Fig. 45.—No. 3 Common, 1″.

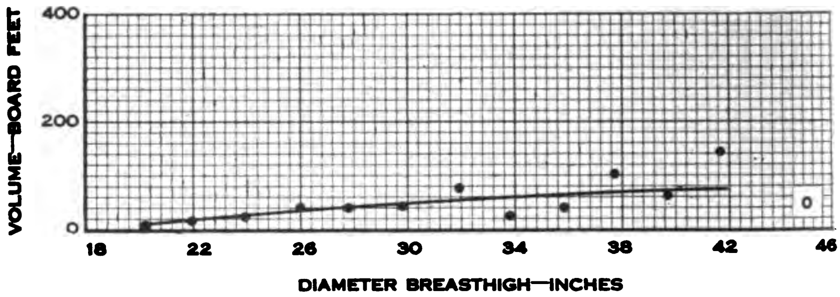

Fig. 46.—Plank, 3".

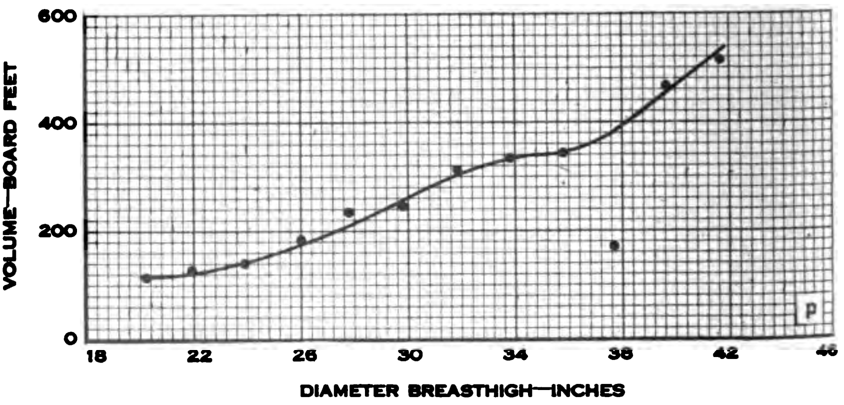

Fig. 47.—4" x 4" and Larger.

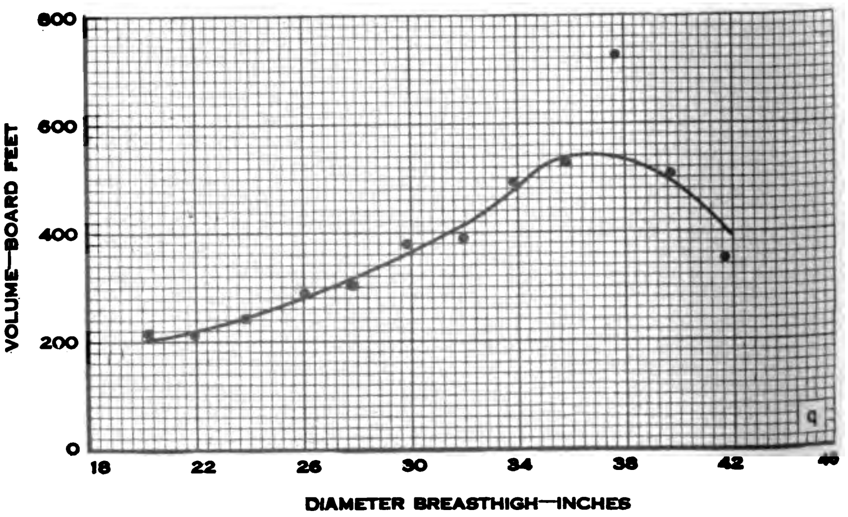

Fig. 48.—2" x 4" and Wider, No. 1 Dim.

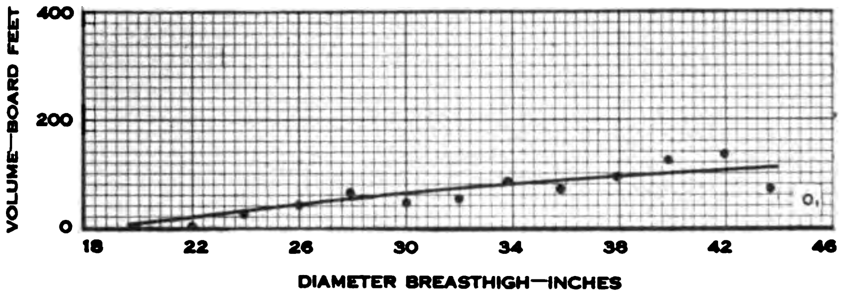

FIG. 49.—Plank, 3".

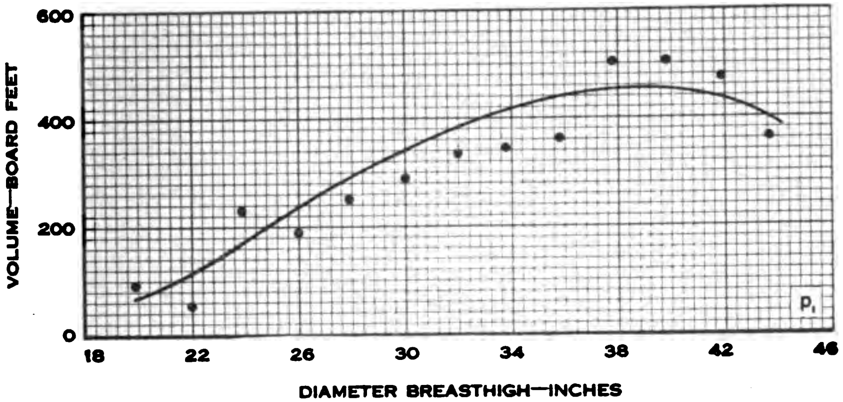

FIG. 50.—4" x 4" and Larger.

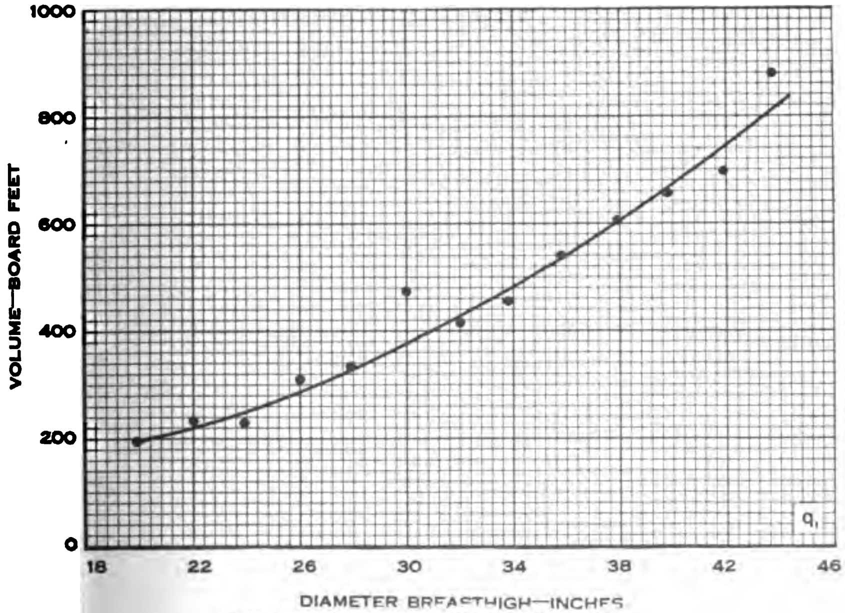

FIG. 51.—2" x 4" and Wider, No. 1 Dim.

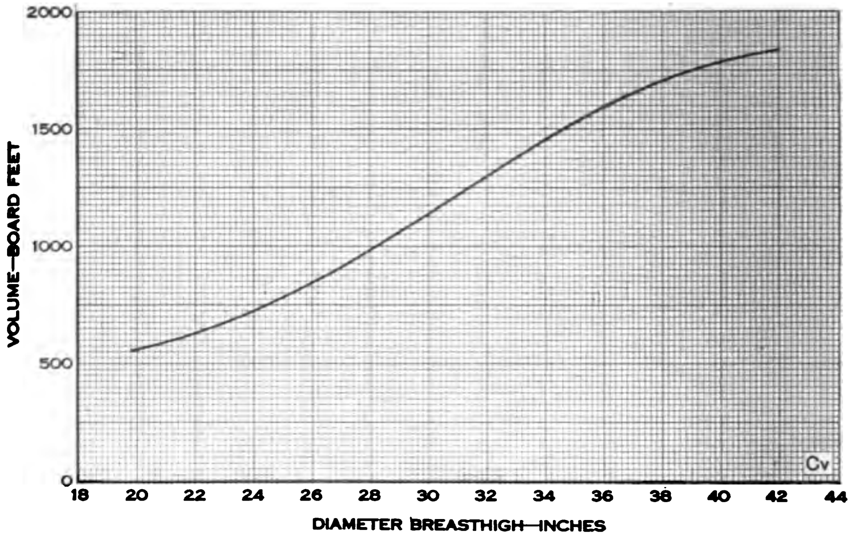

FIG. 52.—Total of low grades sawed from immature trees.

$$j + k + l + m + n + o + p + q = Cv.$$

NOTE.—$Av + Bv + Cv = A$ = Lumber actually sawed out at mill. Curve A is shown in Fig. 11.

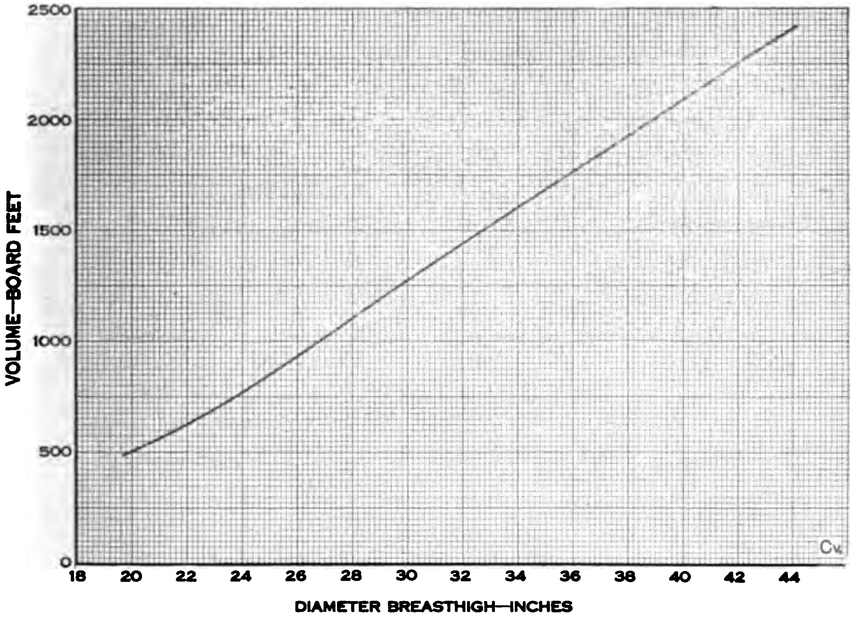

FIG. 53.—Total of low grades sawed from mature trees.

$$j_1 + k_1 + l_1 + m_1 + n_1 + o_1 + p_1 + q_1 = Cv_1.$$

NOTE.—$Av_1 + Bv_1 + Cv_1 = A_1$ = Lumber actually sawed out at mill. Curve A_1 is shown in Fig. 13.

Grades Sawed From Immature Trees of Different Diameters Breast-high, Expressed in Per Cent of Total Sawed Out.

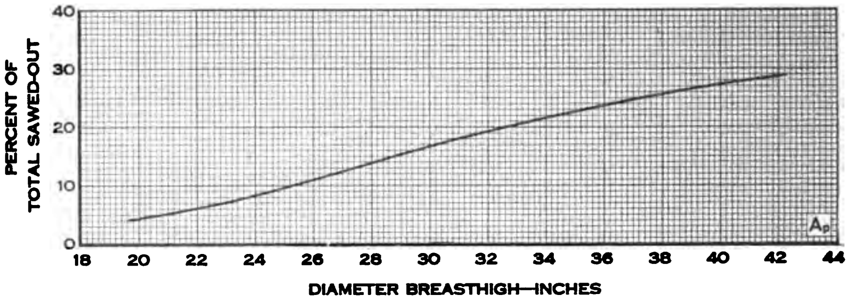

FIG. 54.—High grades. $\frac{100\ Av}{A} = Ap.$

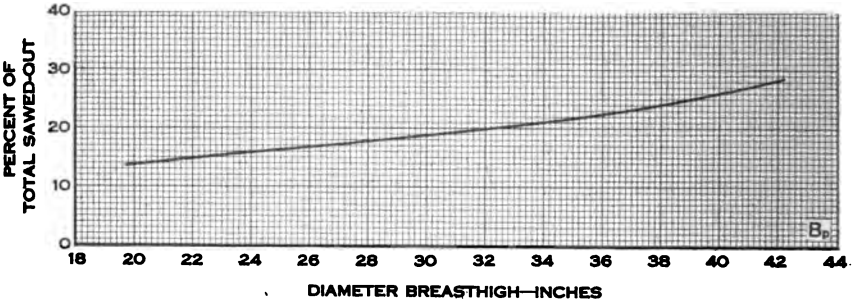

FIG. 55.—Intermediate grades. $\frac{100\ Bv}{A} = Bp.$

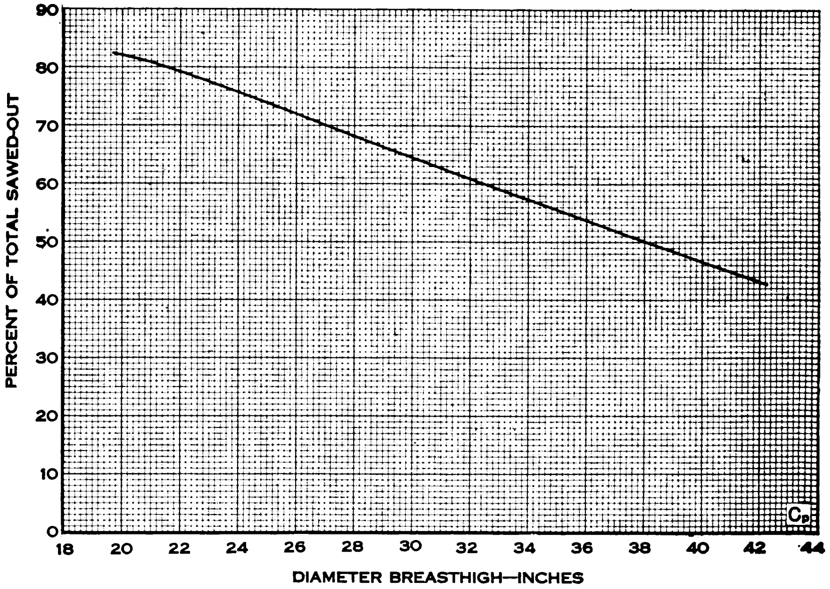

FIG. 56.—Low grades. $\frac{100\ Cv}{A} = Cp.$ $Ap + Bp + Cp = 100\%.$

Grades Sawed From Mature Trees of Different Diameters Breasthigh, Expressed in Per Cent of Total Sawed Out.

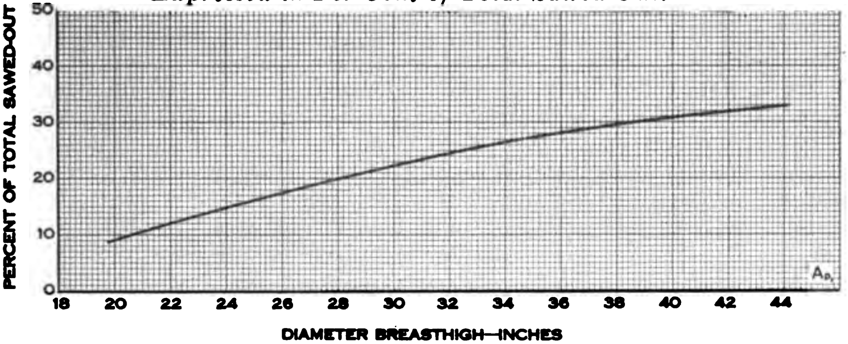

Fig. 57.—High grades. $\frac{100\ Av_1}{A_1} = Ap_1$.

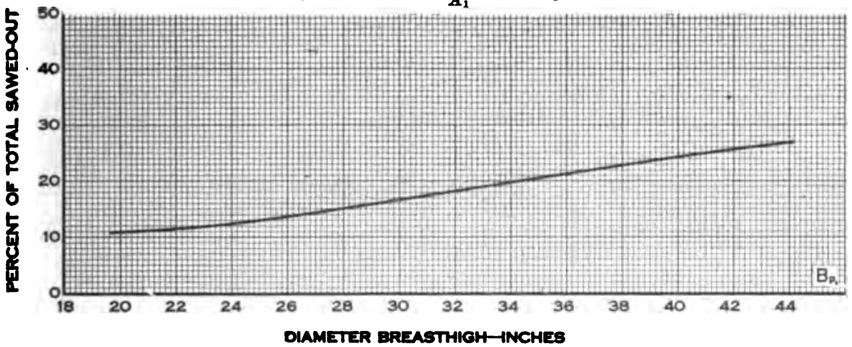

Fig. 58.—Intermediate grades. $\frac{100\ Bv_1}{A_1} = Bp_1$.

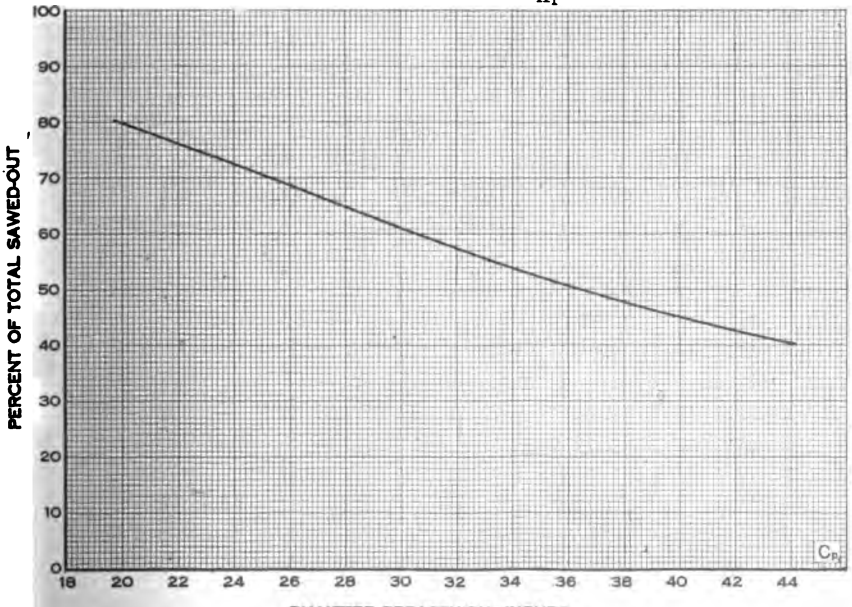

Fig. 59.—Low grades. $\frac{100\ Cv_1}{A_1} = Cp_1$. $Ap_1 + Bp_1 + Cp_1 = 100\%$.

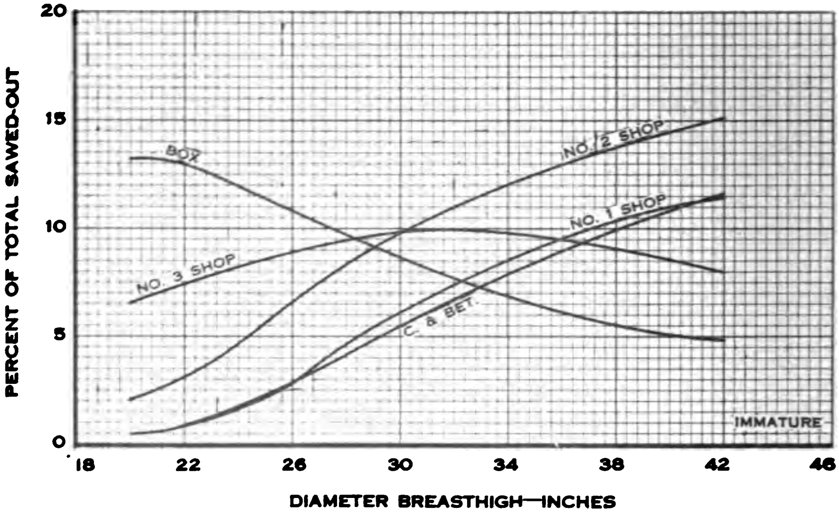

FIG. 60.—A comparison of high, intermediate and low grade curves, which show the total per cent sawed out of each grade from immature trees of different diameters breasthigh. Note the increasing per cent, indicated by the high grades, and the decreasing per cent indicated by the low grades. This is due to quality increment. In no case does the volume in board feet of low grades contained in a tree become smaller, or even hold constant as the tree increases in size; but the fractional part that a certain grade is of the whole merchantable volume may hold constant, decrease or increase, all depending upon the quality of the successive layers of wood formed during growth.

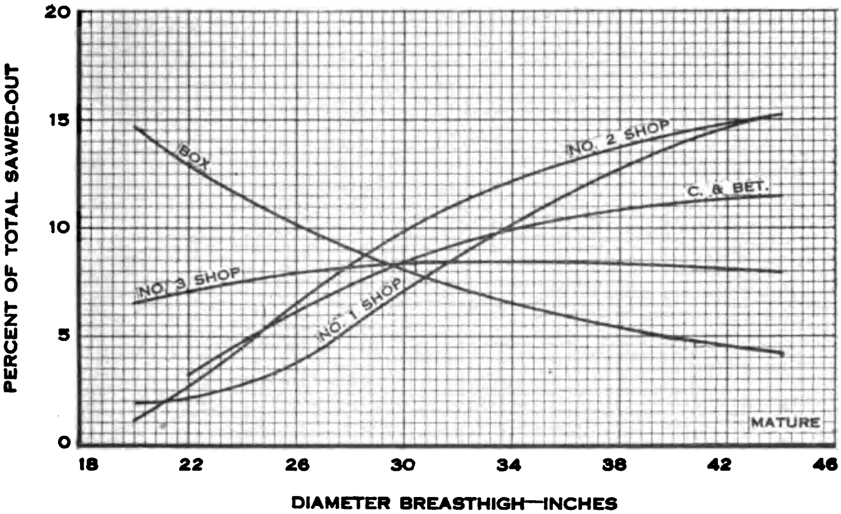

FIG. 61.—A comparison of high, intermediate and low grade curves, which show the total per cent sawed out of each grade from mature trees of different diameters breasthigh. Note the increasing per cent, indicated by the high grades, and the decreasing per cent indicated by the low grades. This is due to quality increment. In no case does the volume in board feet of low grades contained in a tree become smaller, or even hold constant as the tree increases in size; but the fractional part that a certain grade is of the whole merchantable volume may hold constant, decrease or increase, all depending upon the quality of the successive layers of wood formed during growth.

Value.

Value of Grades Sawed From Immature Trees of Different Diameters Breasthigh, Expressed in Dollars and Cents.

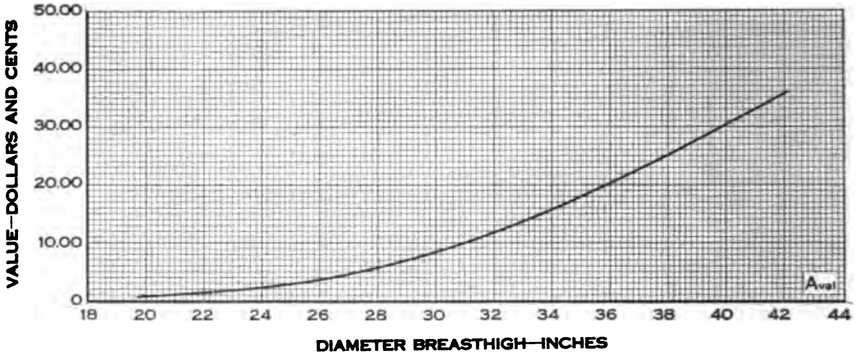

FIG. 62.—High grades.

$$.032a + .030b + .027c + .025d = Aval.$$

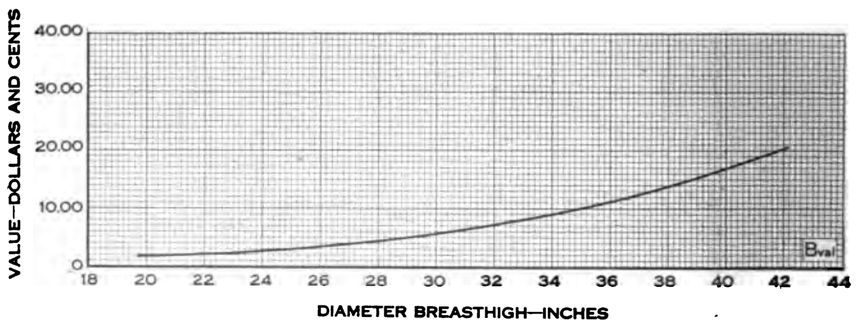

FIG. 63.—Intermediate grades.

$$.022e + .018f + .018g + .018h + .007i = Bval.$$

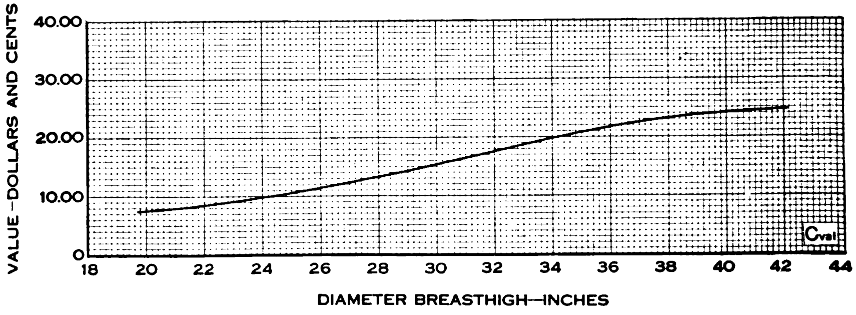

FIG. 64.—Low grades.

$$.009j + .007k + \_\_\_\_\_\_\_ .015q = Cval.$$
$$Aval + Bval + Cval = B = \text{Value per tree.}$$

Value of Grades Sawed From Mature Trees of Different Diameters Breasthigh, Expressed in Dollars and Cents.

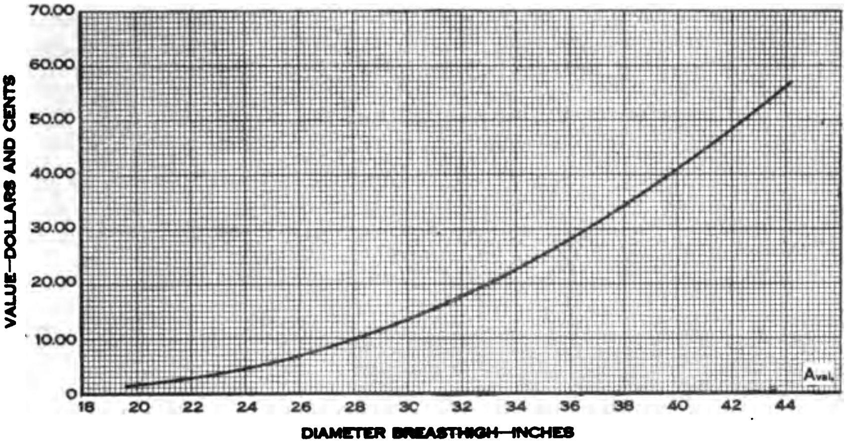

FIG. 65.—High grades.

$$.032a_1 + .030b_1 + .027c_1 + .025d_1 = Aval_1.$$

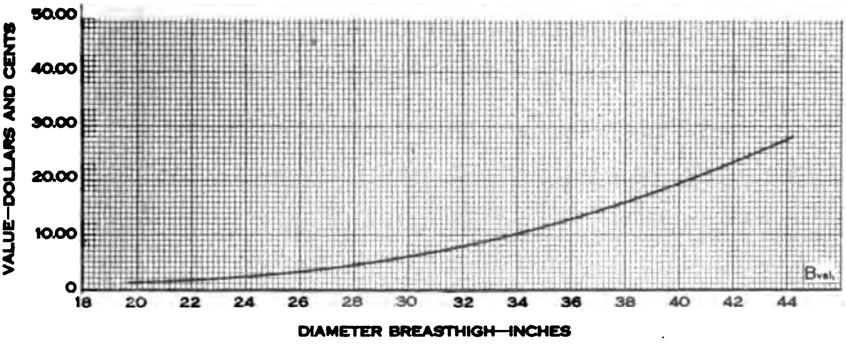

FIG. 66.—Intermediate grades.

$$.022e_1 + .018f_1 + .018g_1 + .018h_1 + .007i_1 = Bval_1.$$

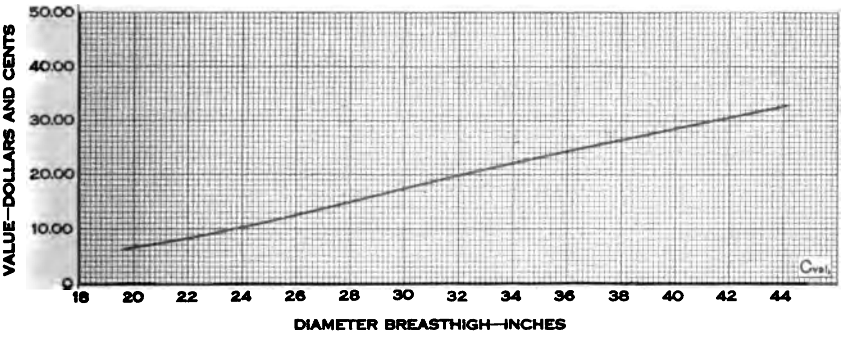

FIG. 67.—Low grades.

$$.009j_1 + .007k_1 + \text{--------} .015q_1 = Cval_1.$$

$$Aval_1 + Bval_1 + Cval_1 = B_1 = \text{Value per tree.}$$

Curves Showing Average Value per Tree and per 1,000 Board Feet for Immature Western Yellow Pine.

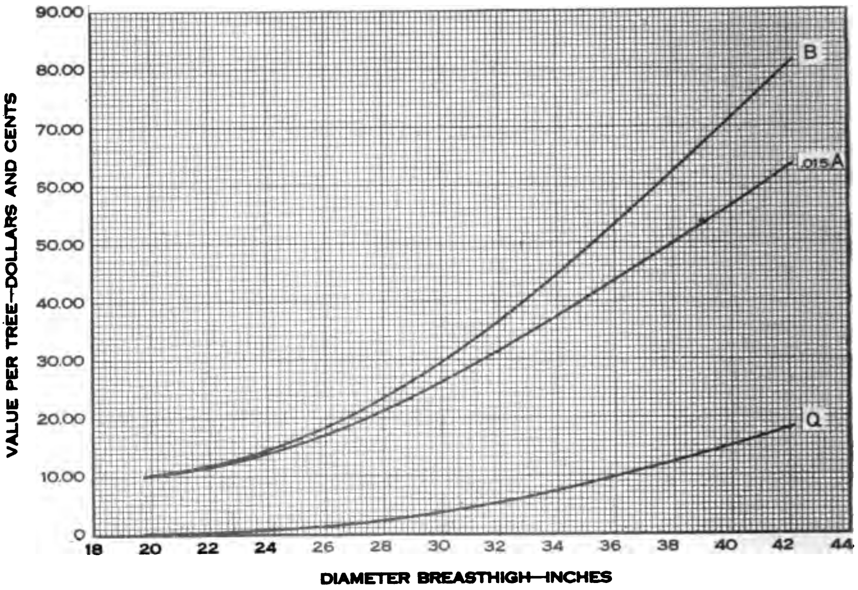

FIG. 68.—Curve B shows the average value, in dollars and cents, of immature trees of different diameters breasthigh. $B = Aval + Bval + Cval$. Curve .015A shows the increase in value due to quantity increment. Curve Q shows the increase in value due to quality increment.

$$.015A + Q = B.$$

Curves Showing Average Value per Tree and per 1,000 Board Feet for Mature Western Yellow Pine.

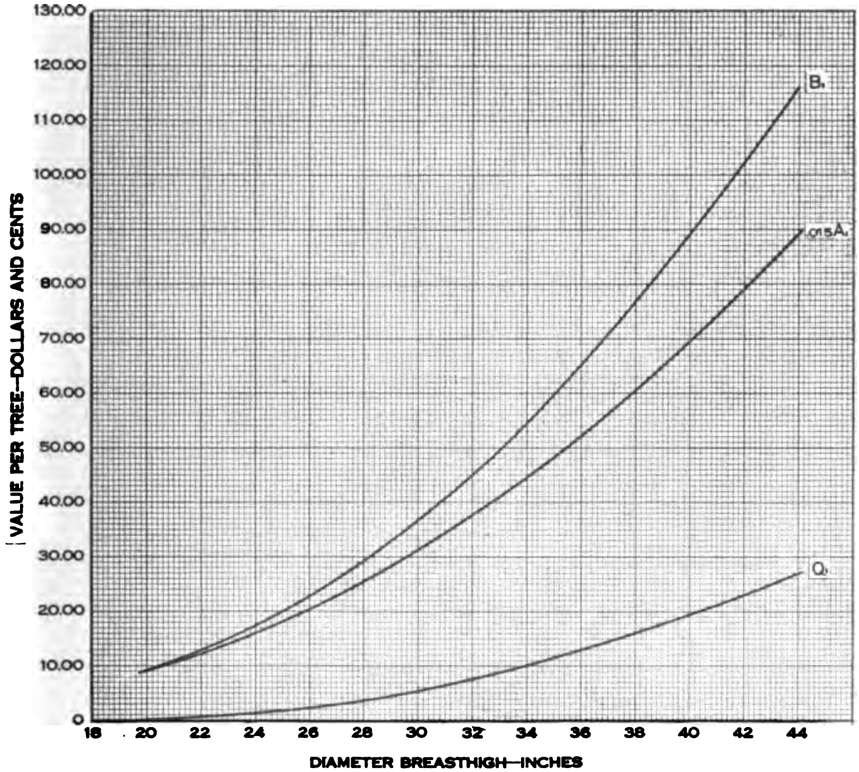

Fig. 69.—Curve B_1 shows the average value, in dollars and cents, of mature trees of different diameters breasthigh. $B_1 = Aval_1 + Bval_1 + Cval_1$. Curve $.015A_1$ shows the increase in value due to quantity increment. Curve Q_1 shows the increase in value due to quality increment.

$$.015A_1 + Q_1 = B_1.$$

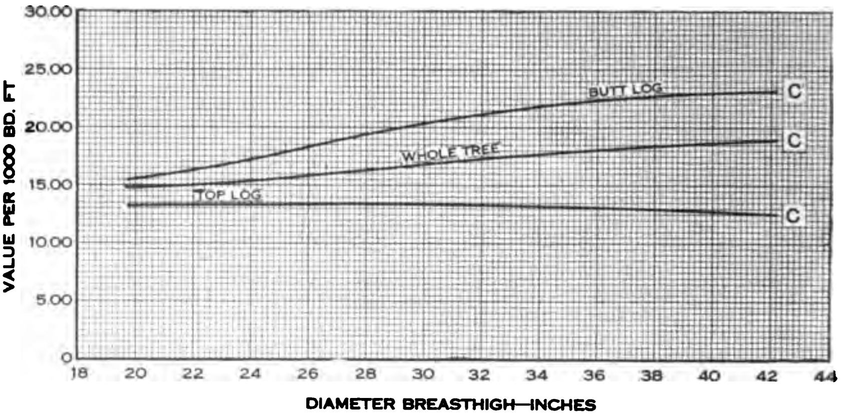

FIG. 70.—Curves showing the value in dollars and cents per thousand board feet of lumber sawed from butt logs, whole trees, and top logs, of immature trees of different diameters breasthigh.

$$\frac{1000\,B}{A} = C = \text{Value per 1000 B.M.}$$

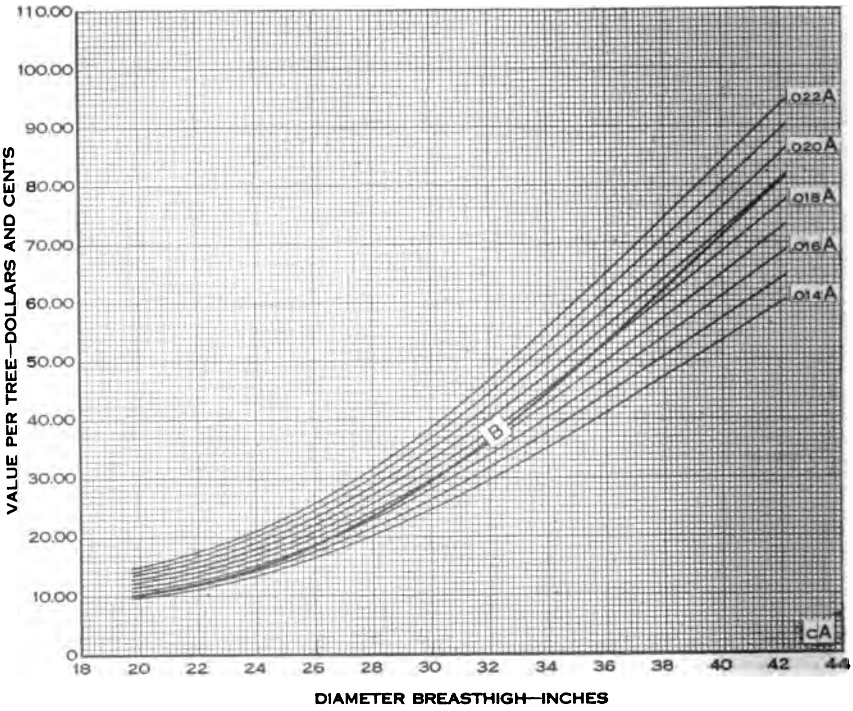

FIG. 71.—Curve B, showing average values in dollars and cents of immature trees of different diameters breasthigh, contoured for quality. (This illustrates to what extent the quality increment affects the value per tree. Both value per tree and per 1000 board feet can be read from this curve.)

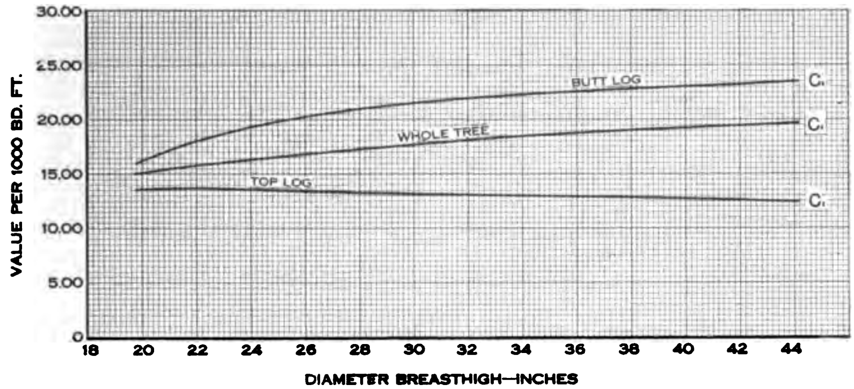

FIG. 72.—Curves showing the value in dollars and cents per thousand board feet of lumber sawed from butt logs, whole trees and top logs, of mature trees of different diameters breasthigh.

$$\frac{1000\ B_1}{A_1} = C_1 = \text{Value per 1000 B.M.}$$

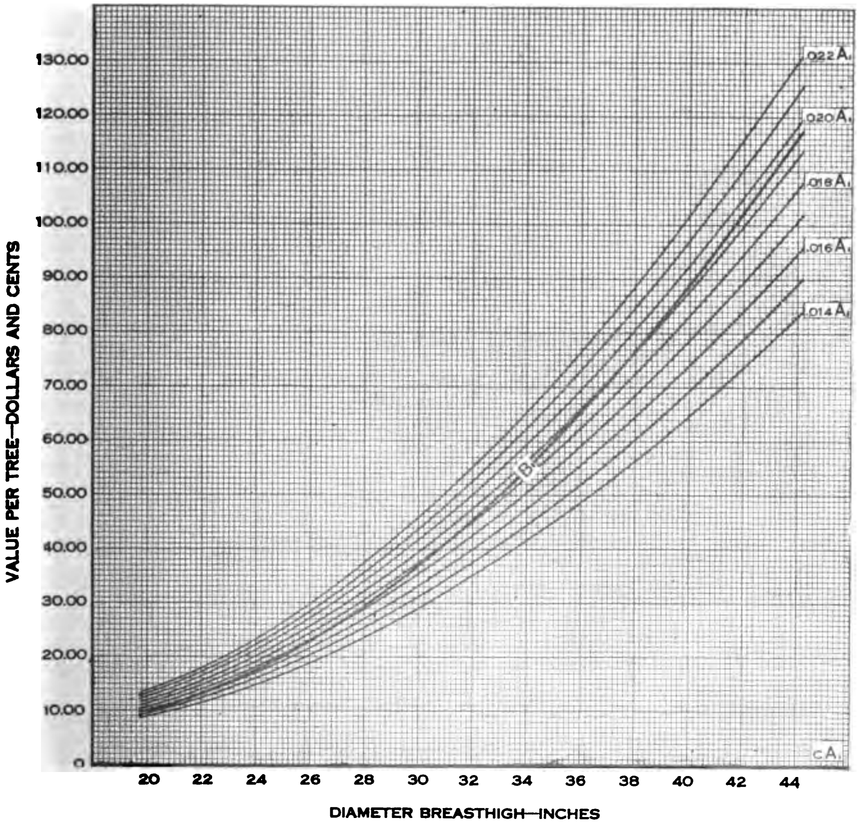

FIG. 73.—Curve B_1, showing average values in dollars and cents of mature trees of different diameters breasthigh, contoured for quality. (This illustrates to what extent the quality increment affects the value per tree. Both value per tree and per 1000 board feet can be read from this curve.)

Volume Contoured for Height.

Contoured curves showing average volume in board feet, also in cubic feet, contained in merchantable portion of immature trees, of different merchantable lengths, and diameters breasthigh.

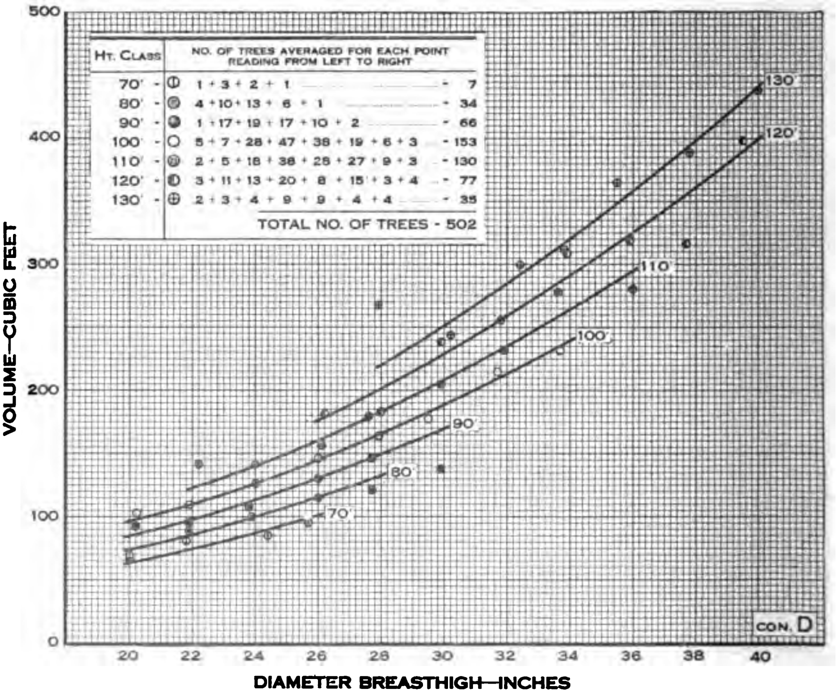

FIG. 74.—Total volume in cubic feet inside bark from the stump to a height where the tree is 6" in diameter outside the bark.

Contoured curves showing average volume in board feet, also in cubic feet, contained in merchantable portion of mature trees, of different merchantable lengths, and diameters breasthigh.

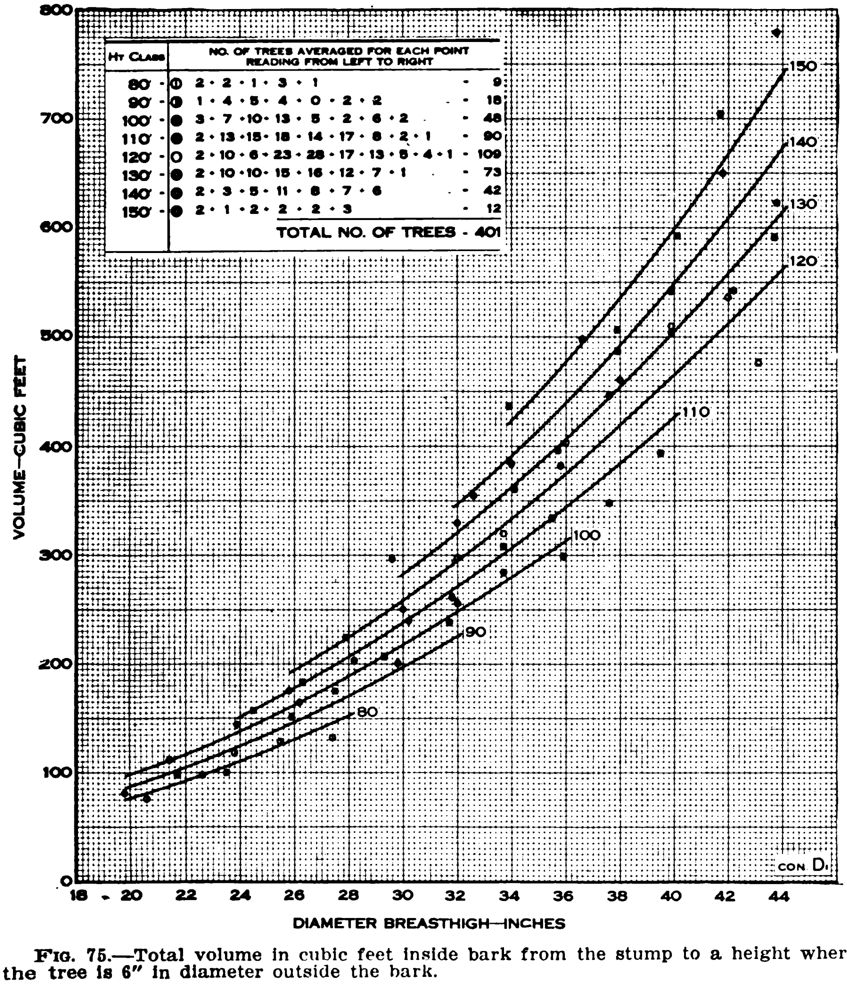

FIG. 75.—Total volume in cubic feet inside bark from the stump to a height where the tree is 6" in diameter outside the bark.

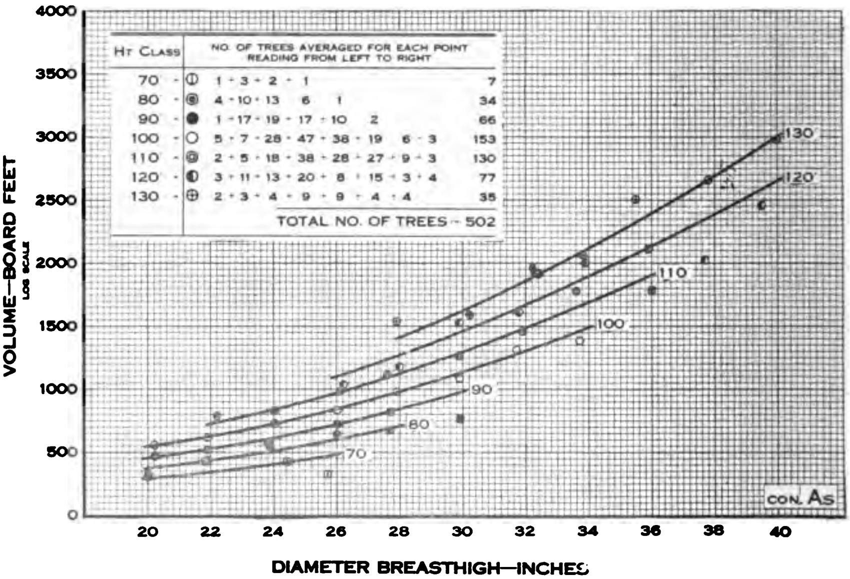

FIG. 76.—Total volume in board feet as shown by the Spaulding Log Rule.

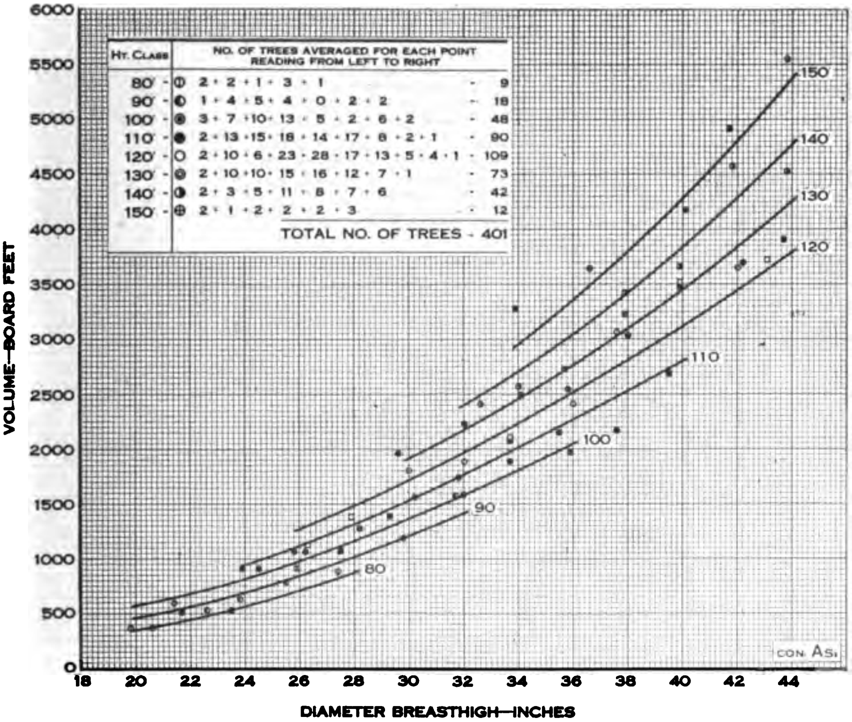

FIG. 77.—Total volume in board feet as shown by the Spaulding Log Rule.

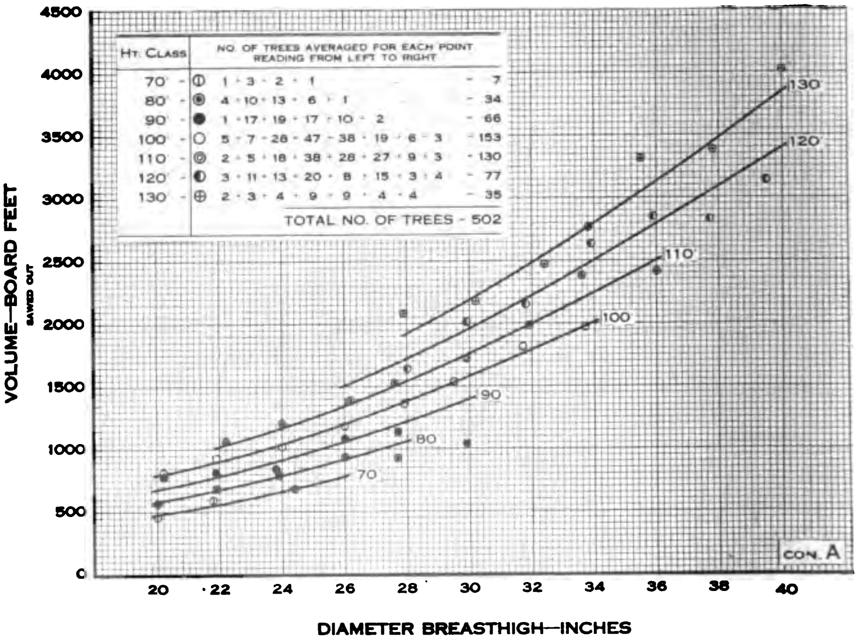

FIG. 78.—Total volume in board feet actually "sawed out" at mill.

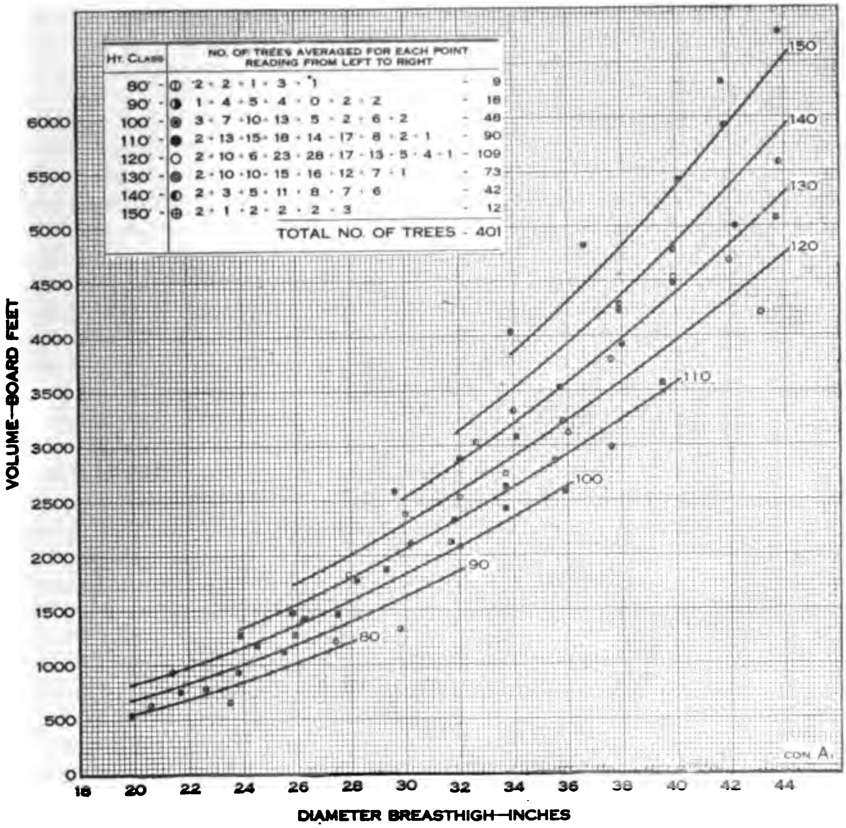

FIG. 79.—Total volume in board feet actually "sawed out" at mill.

Growth.

The growth determinations shown in the following diagrams are based on measurements of the average radii of stumps of felled trees of known dimensions. The average rate of growth of each individual tree, as shown by the last fifty annual rings formed, or last fifty years of the life of each tree, was determined. These rates were then corrected so as to read at diameter breasthigh by means of reducing factors, as shown in Figs. 81 and 82. Trees were then grouped in diameter classes, and those of each diameter class were arranged according to rate of growth, from the minimum to the maximum. The number of trees forming each class is the sample of that class, and an individual tree therefore may represent a large percentage of the sample or a small one, all depending upon the total number of trees included in the class.

The larger the number of trees composing a sample the more authentic are the final results, since the variability from the true minimum to the true maximum can thus be more closely obtained. In any sample on rate of growth it would be absurd to assume that the minimum indicated applied to the slowest growing tree in the timber region being studied, or that the maximum of the sample was the fastest growing tree. After determinations on about seventy-five or one hundred trees have been made for a diameter class, the value of the sample is increased very slowly by the addition of more trees; since the principal effect of additional trees will be to lower the minimum and raise the maximum, while the body of the sample will be practically unaffected.

In Figs. 83 and 84 samples for the various diameter classes are compared. These samples are not composed of the same number of trees; had they been, the final results would have been very little different from these here given. In fact, the number of trees comprising each diameter class shown in Figs. 83 and 84 is a better sample than though the number in each case were the same, since these numbers are to a large degree representative of the quantity of trees of each diameter class to be expected from a given tract similar to the one under consideration.

Curves shown in Figs. 85 and 86 are plotted directly from Figs. 83 and 84, and show the rate of growth per decade at diameter breasthigh of trees of different sizes. Curves 87 and 89 were obtained by plotting the increments of total sawed out volume in board feet as indicated by the diameter growth. Figs. 88 and 90 were obtained by expressing curves in Figs. 87 and 89 in per cent of total sawed out.

Curves shown in Figs. 91 and 93 were obtained by plotting increments of total value per tree, as indicated by the diameter growth for the average, and then for the highest and lowest ten per cent, while Figs. 92 and 94 show the same results expressed as a per cent of the total value per tree.

The relation of growth to grades or quality.

Wood formed by the growth of western yellow pine trees after they have reached maturity is very fine grained, free from knots in the lower part and uniform in texture. No new limbs are formed after maturity, as evidenced by the absence of small live branches. All living branches are large, and usually high up in the tree. Therefore, no new knots are formed, and the tendency of the tree is to cover up by the newly formed wood of each season's growth the knots formed in early life by the growth of small limbs which eventually die and drop off.

Retardation in growth continues in mature trees until the rate of growth in radius measured on the stump becomes less than one-tenth of an inch in a period of ten years. Such a low rate is hardly sufficient to sustain life, and it is safe to say that the deterioration in such trees will more than offset increase in value due to growth.

Lumber of all grades usually can be sawed from a fair sized mature tree. In the butt log will be found high grade, clear material, and in large logs several boards of clear lumber may be sawed without changing the position of the log before defects in the form of knots are reached. These knots found in the center of all butt logs are usually small and numerous, since they are the remaining evidence of limbs formed in the early life of the tree. They become smaller and more numerous as the center of the log is approached. The mark of every limb that the tree ever had at heights not exceeding the point where the butt log was sawed are in evidence, and always have held the same position in the tree that they originally held—always the same distance from the ground, etc. The butt log contains wood formed at all stages of the tree's life. The quality ranges from clear, straight, fine-grained material found in the layers near the bark to coarse-grained lumber found below this, and, finally, to fine-grained lumber containing numerous pin knots found in the center.

The second log up from the stump contains none of the wood formed while the tree's height was less than the length of the butt log plus the height of the stump. The quality is about the same as found in the butt log, with the exception that the clear material near the bark is not quite as thick, and the knots in the center of the log are larger. This is due to the fact that the tree was larger and older when the wood in the center of the second log was formed, and therefore maintained a crown composed of larger limbs than it did when forming the wood composing the center of the butt log.

The third log from the stump contains none of the wood formed while the tree's height was less than the length of the butt log plus the length of the second plus the height of the stump. Stubs of the old limbs which once formed the crown may be seen still penetrating through the bark. Some of them may be between three and four inches in diameter, and in cases where the tree grew in the open they may be still alive and five or six inches in diameter. The quality of lumber to be expected from this part of the tree may range from Number 1 Shop found near the bark to Number 3 Shop, Number 3 Common and Box found in the center.

In all cases the knots will be much larger in the third log than in the second, and larger in the second than in the butt log. The fourth log up from the stump will contain none of the wood found while the tree's height was less than the distance from the ground to the position occupied in the tree by the large end of this log. Usually a great many stubs of dead limbs are present and there may be quite a few live branches. Only in exceptional cases will it be possible to saw clear material from this part of the tree. The first cut generally yields

Number 2 Shop, and in some cases Number 1 Shop. The knots are larger and farther apart than in any of the logs located farther down, and it is this type of material that can be graded as Shop lumber, since boards free from small knots and containing large ones will usually pass the qualifications of these grades. The center of the log will produce lumber containing many knots of various sizes, and the quality will compare favorably with that of the center of logs nearer the stump. The strength will probably be greater, since the wood was formed after the tree had a good start in life. The grain will be coarser than will be found in the center of the lower logs, but the wood in general will not be as brittle. Timbers cut from this part of the tree will manifest more strength, if the knots are sound, than ones cut from the butt and second logs, which contain wood at the center apt to be brittle, due to the fact that it was laid on before the tree had become vigorous.

All logs above the fourth from the stump will contain large knots extending through the bark in the form of snags and live limbs. The largest knots are generally ones formed by the presence of living branches. The center of these logs will usually grade as Number 3 Shop, Number 3 Common, and Box. The last log in a mature tree has an enormous taper, and the knots are very large. They produce a low grade of lumber, such as Box and Number 3 Common.

The quality of material once formed in a tree, with the exception of the gradual change from sap-wood to heart-wood, remains unchanged by the process of growth. The new layers of wood formed from year to year increase the quality of the tree as a whole, and small and intermediate sized knots are covered by successive layers until clear, straight grained lumber results in the lower portion of the bole near the barked surface in sufficient quantities to be manufactured into boards of various dimensions.

A tree contains all wood formed by the process of growth from its beginning up to the time it is milled, and each layer is unaffected by the formation and accumulation of other layers which follow. The same knots are present in the same location in the tree, and the grain of the wood once formed remains unchanged.

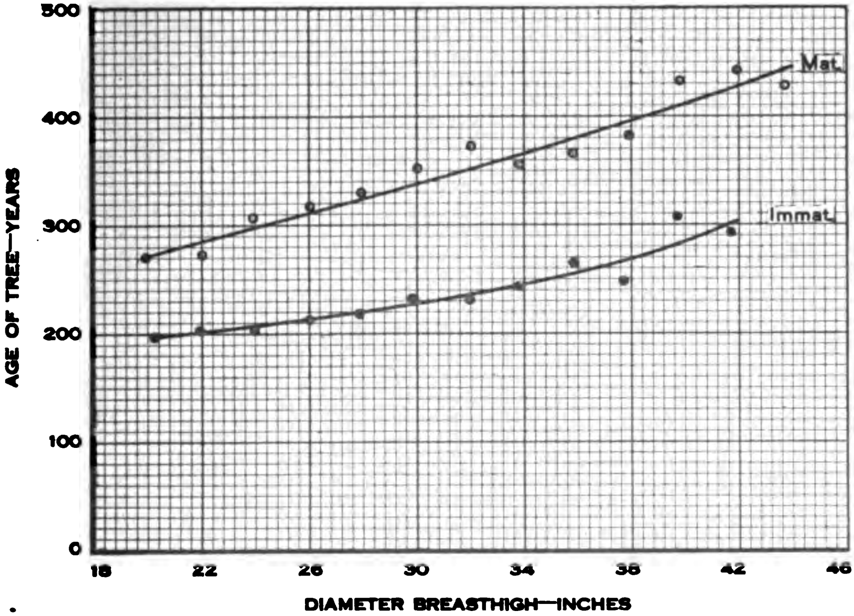

FIG. 80.—Curves showing average age in years of immature and mature western yellow pine trees of different diameters breasthigh.

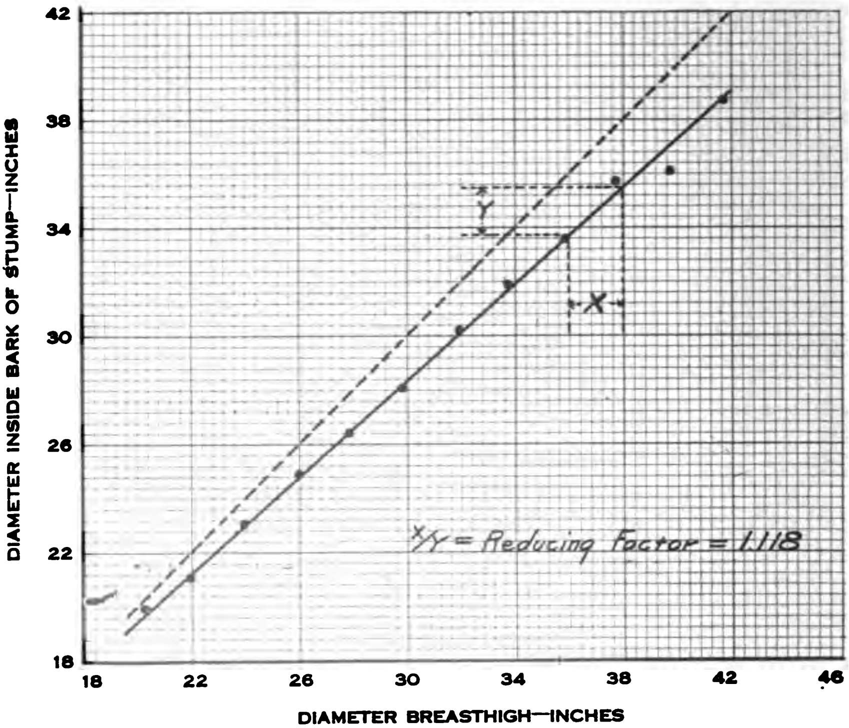

FIG. 81.—Curve showing the relation between diameter inside bark of stump and diameter breasthigh of immature trees. X/Y = reducing factor = 1.118. **This factor is used to reduce growth measurements made on the stump to read at diameter breasthigh.**

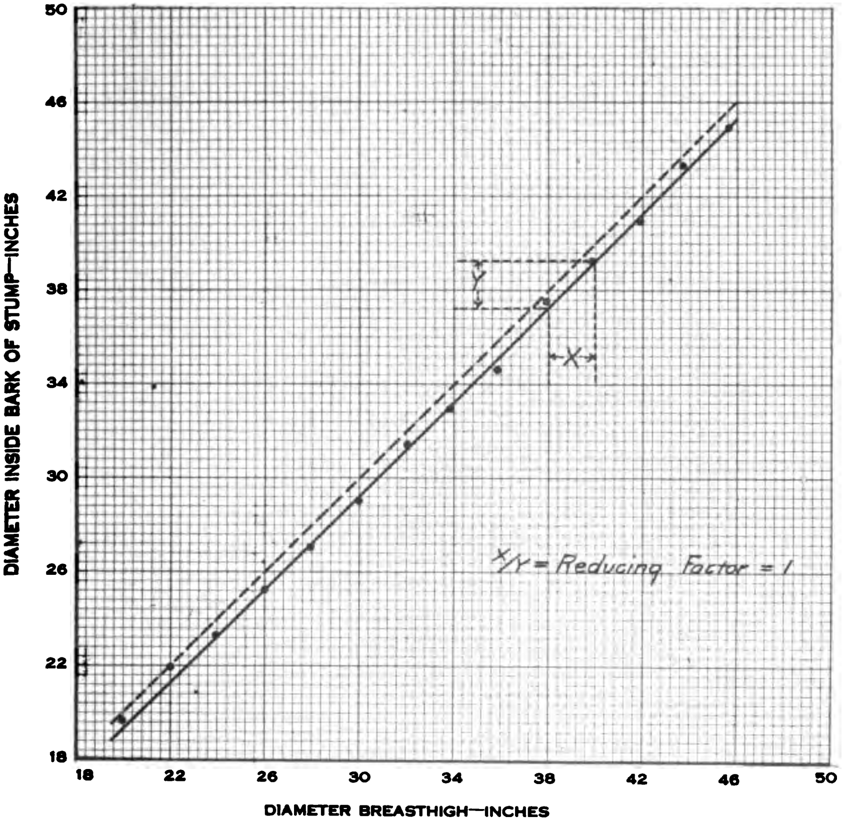

FIG. 82.—Curve showing the relation between diameter inside bark of stump and diameter breasthigh of mature trees. $X/Y =$ reducing factor $= 1.000$. This factor is used to reduce growth measurements made on the stump to read at diameter breasthigh.

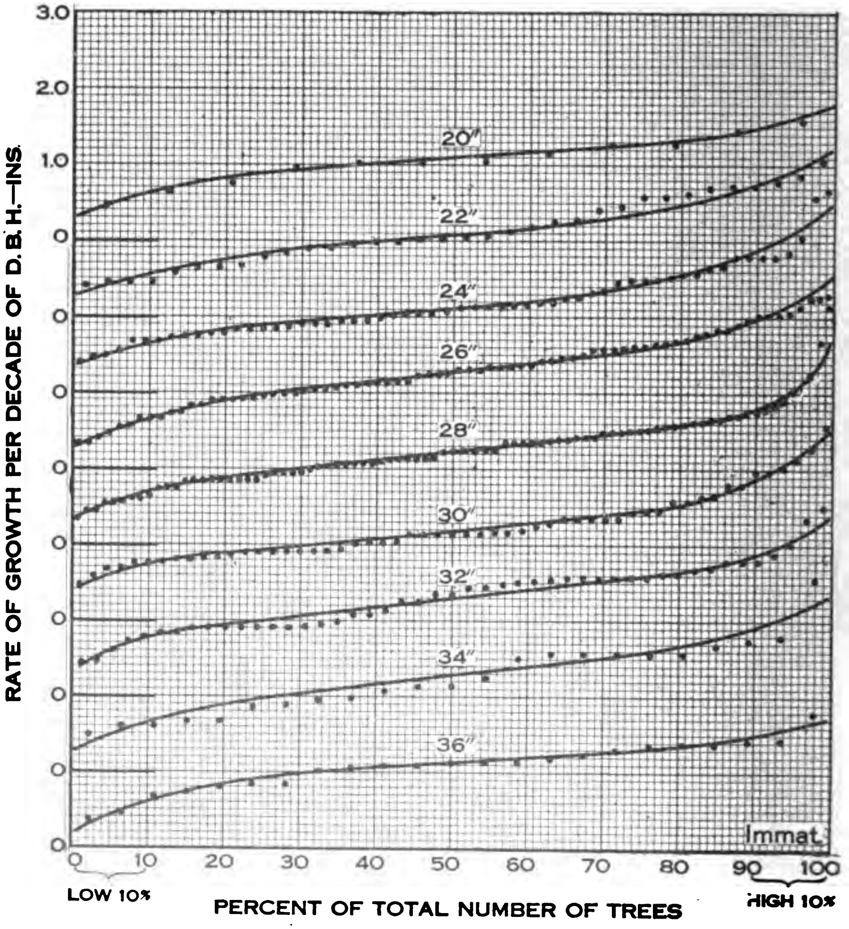

FIG. 83.—Curves showing the rate of growth per decade of diameter breasthigh of immature trees. The top curve marked 20" is based upon as many trees as there are points on the curve (12), and is constructed by arranging these trees in order of rate of growth from the minimum to the maximum, and plotting rates of growth per decade for ordinates and per cent of the total number of trees, which constitutes the sample, for abscissa. The other curves shown in this figure were constructed in like manner.

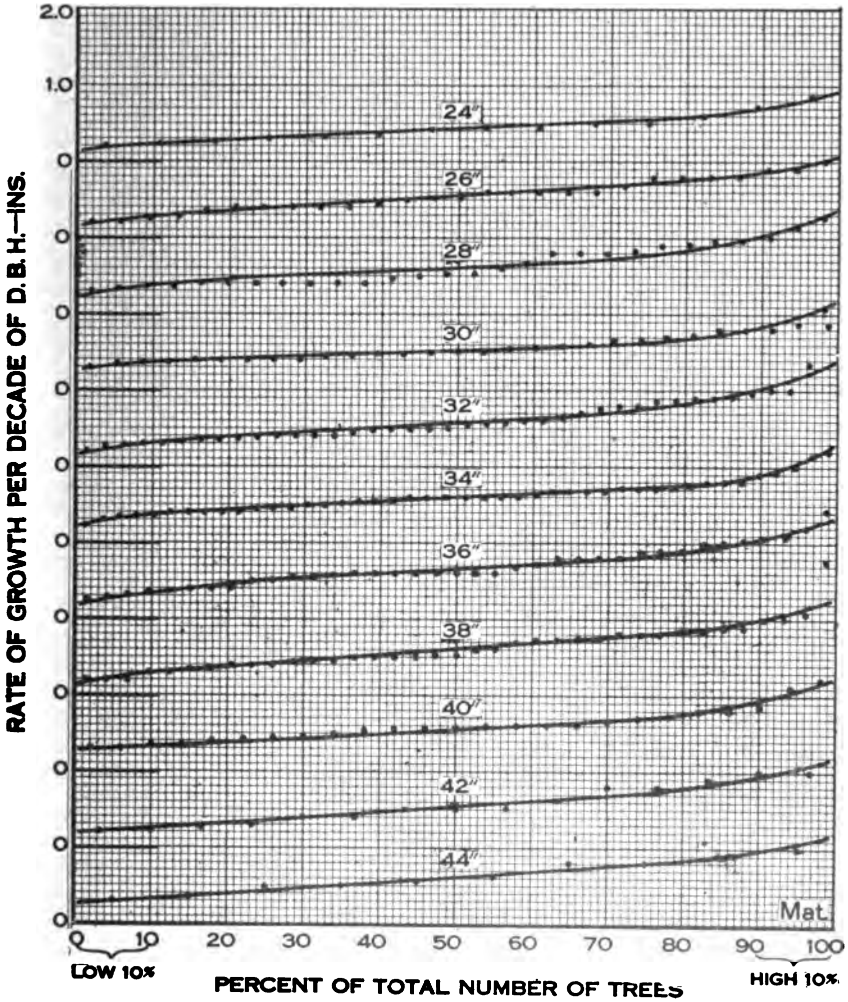

Fig. 84.—Curves showing the rate of growth per decade of diameter breasthigh of mature trees. The top curve marked 20" is based upon as many trees as there are points on the curve (14), and is constructed by arranging these trees in order of rate of growth from the minimum to the maximum, and plotting rates of growth per decade for ordinates and per cent of the total number of trees, which constitutes the sample, for abscissa. The other curves shown in this figure were constructed in like manner.

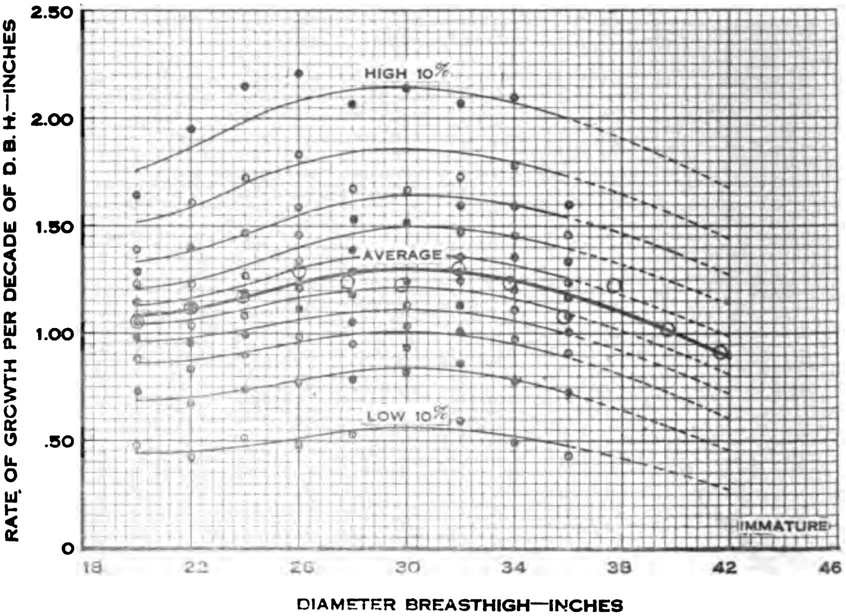

FIG. 85.—Curves obtained directly from Fig. 83, showing rates of growth per decade of diameter breasthigh, of immature trees. These curves show rates for the lowest ten per cent of trees, next to the lowest ten per cent, etc., to the highest ten per cent. The average curve is plotted from averages of all rates for each diameter class.

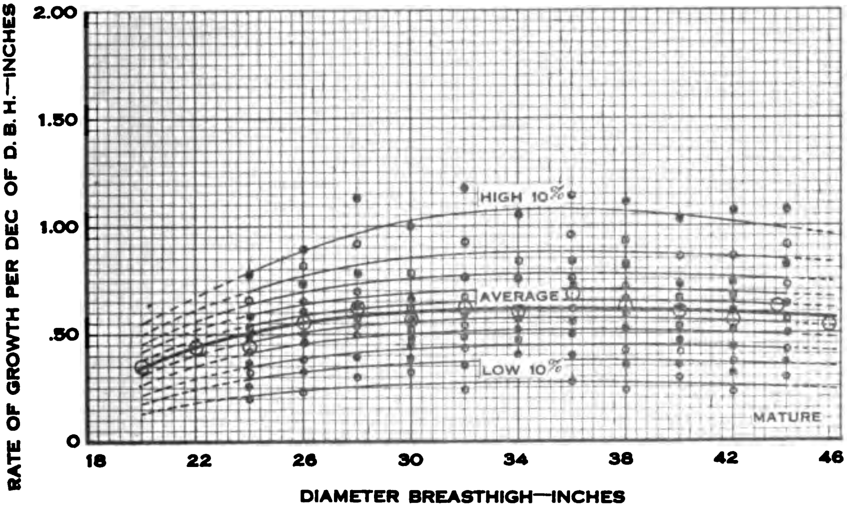

FIG. 86.—Curves obtained directly from Fig. 84, showing rates of growth per decade of diameter breasthigh, of mature trees. These curves show rates for the lowest ten per cent of trees, next to the lowest ten per cent, etc., to the highest ten per cent. The average curve is plotted from averages of all rates for each diameter class.

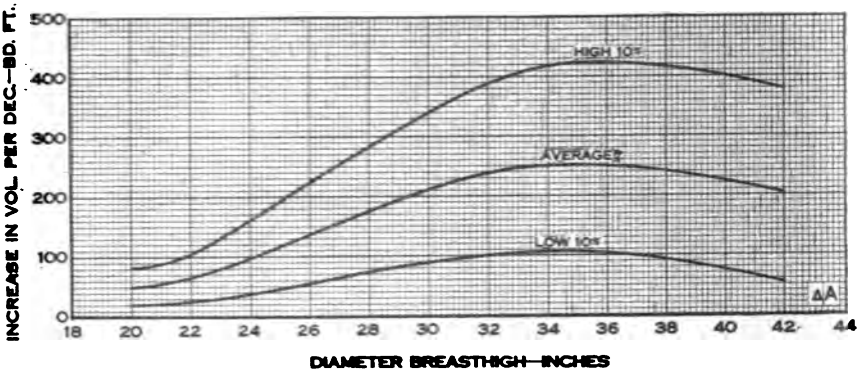

FIG. 87.—Curves showing increase in merchantable volume per decade of immature trees of different diameters breasthigh. These curves are constructed by plotting the increment of volume from curve A, the total merchantable volume curve, corresponding to the increment of growth in diameter breasthigh as shown in Fig. 83 for immature trees of different diameters.

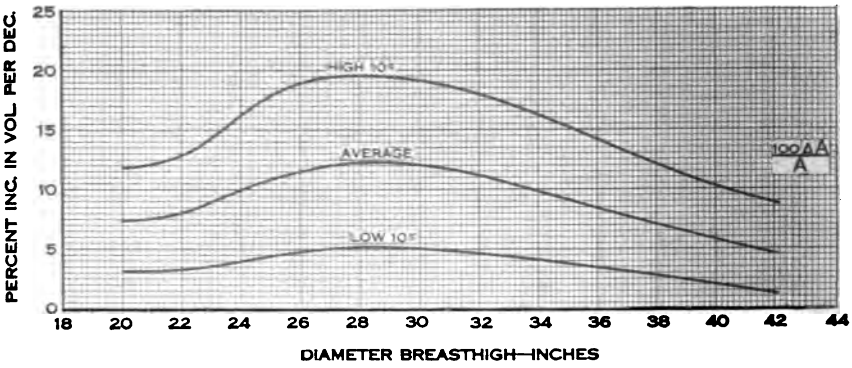

FIG. 88.—Curves showing per cent of increase in merchantable volume per decade, of immature trees of different diameters. These curves are obtained by expressing the values shown in Fig. 87 in per cent of merchantable volume, or $\frac{\text{curve}}{\text{curve A}} \times 100 =$ per cent increase in volume per decade.

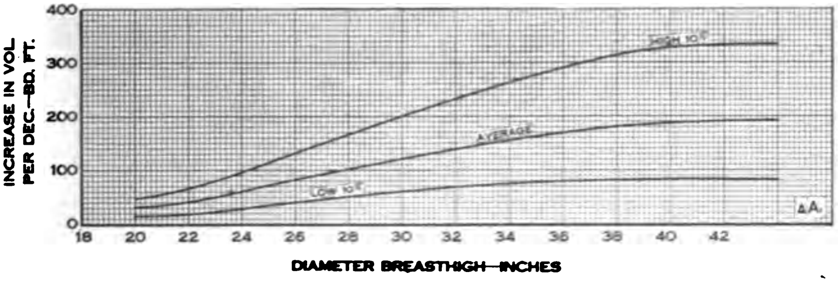

FIG. 89.—Curves showing increase in merchantable volume per decade of mature trees of different diameters breasthigh. These curves are constructed by plotting the increment of volume from curve A_1, the total merchantable volume curve, corresponding to the increase in grown in diameter breasthigh, as shown in Fig. 84, for mature trees of different diameters.

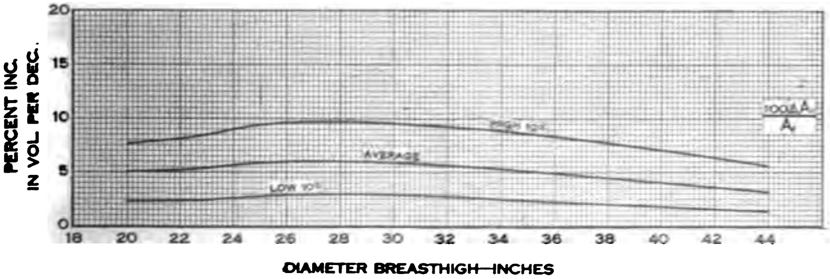

FIG. 90.—Curves showing per cent of increase in merchantable volume per decade, of mature trees of different diameters. These curves are obtained by expressing the values shown in Fig. 89 in per cent of merchantable volume, or $\frac{\text{curve } \Delta A_1}{\text{curve } A_1} \times 100 =$ per cent increase in volume per decade.

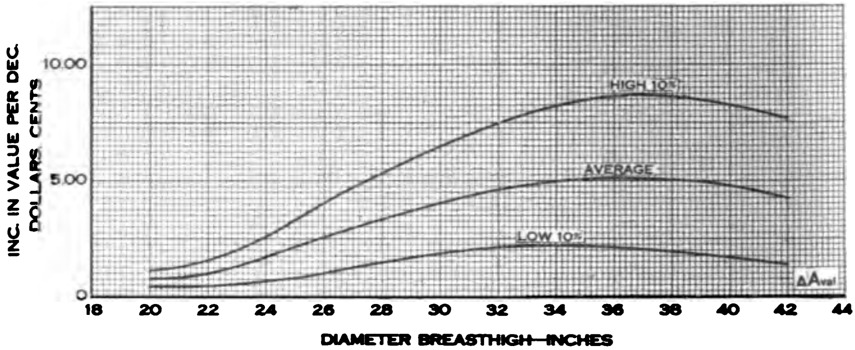

FIG. 91.—Curves showing increase in value per decade in dollars and cents of immature trees of different diameters breasthigh. These curves are constructed by plotting the increment of value from "B," the total value curve, corresponding to the increment of growth in diameter breasthigh shown in Fig. 83, for trees of different diameters.

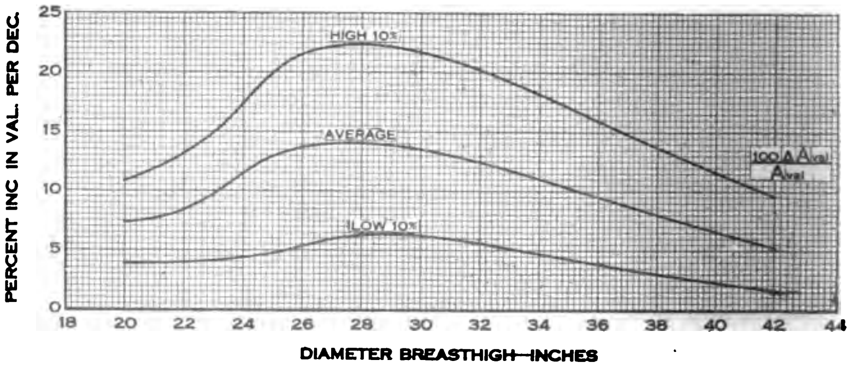

FIG. 92.—Curves showing per cent increase in value per decade of immature trees of different diameters breasthigh. These curves are obtained by expressing the values shown in Fig. 91 in per cent of total value of trees of different diameters, or

$\frac{\text{curve } \triangle \text{ B}}{\text{curve B}} \times 100 =$ per cent increase in value, in dollars and cents, per decade of growth.

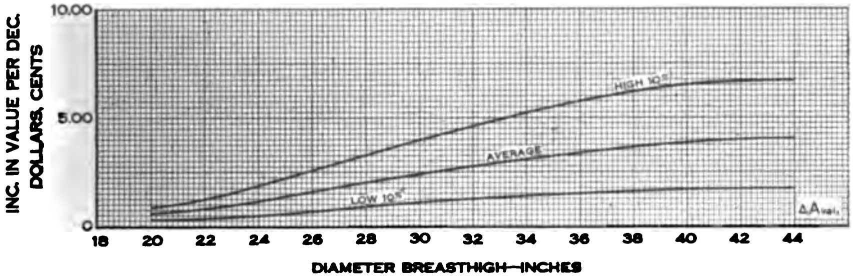

FIG. 93.—Curves showing increase in value per decade in dollars and cents of mature trees of different diameters breasthigh. These curves are constructed by plotting the increment of value from "B_1," the total value curve, corresponding to the increment of growth in diameter breasthigh shown in Fig. 84, for trees of different diameters.

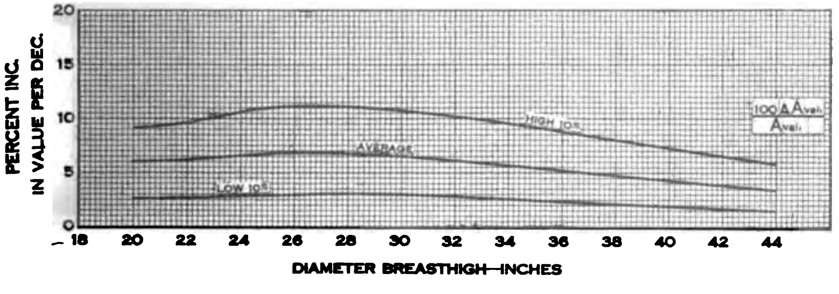

FIG. 94.—Curves showing per cent increase in value per decade of mature trees of different diameters breasthigh. These curves are obtained by expressing the values shown in Fig. 93 in per cent of total value of trees of different diameters, or

$$\frac{\text{curve } \triangle B_1}{\text{curve } B_1} \times 100 = \text{per cent increase in value, in dollars and cents, per decade of growth.}$$

FOR BUTT LOGS.

Volume.

Curves showing average total volume in board feet contained in 16′ butt logs from immature western yellow pine trees of different diameters breasthigh.

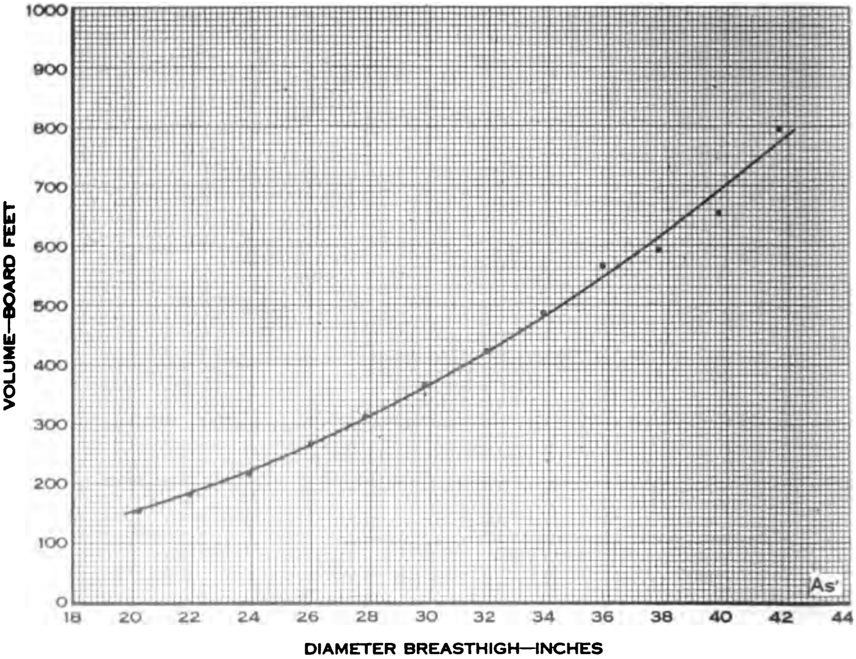

Fig. 95.—Total volume in board feet as shown by the Spaulding Log Rule.

Curves showing average total volume in board feet contained in 16′ butt logs from mature western yellow pine trees of different diameters breasthigh.

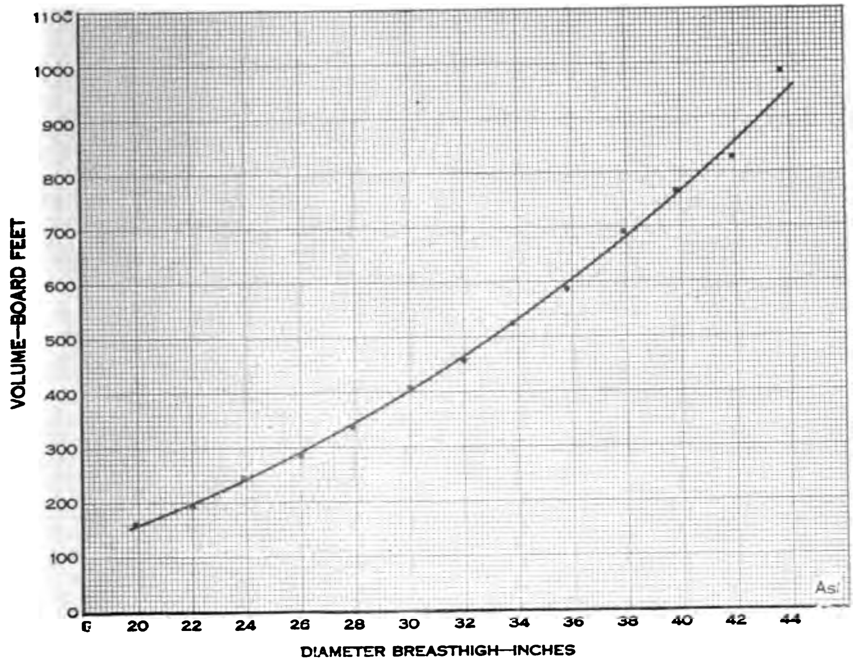

FIG. 96.—Total volume in board feet as shown by the Spaulding Log Rule.

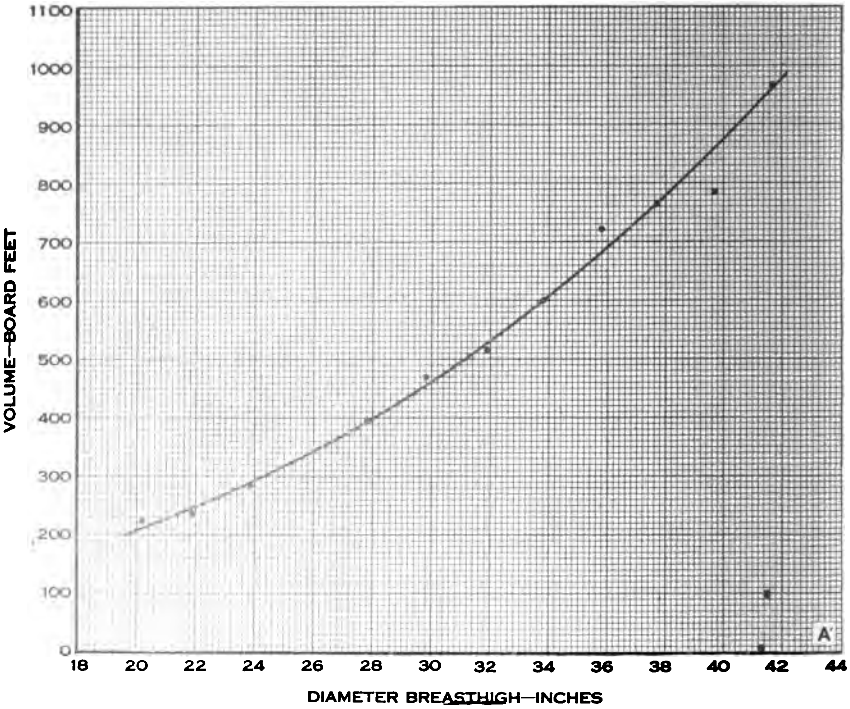

FIG. 97.—Total volume in board feet actually "sawed out" at mill.

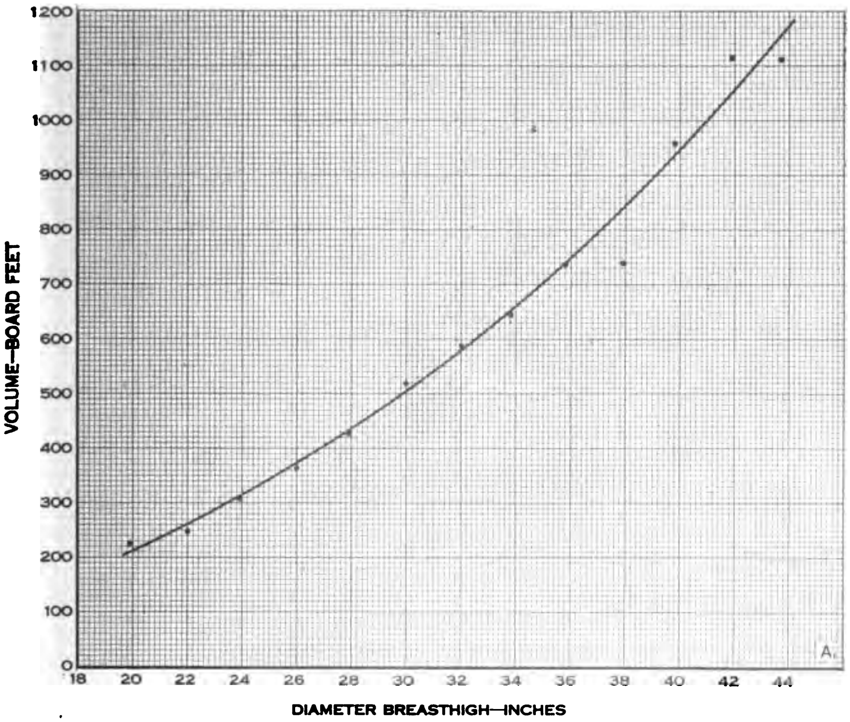

FIG. 98.—Total volume in board feet actually "sawed out" at mill.

Curves showing average volume in board feet of each grade actually "sawed out" at mill, from 16′ butt logs of immature western yellow pine trees of different diameters breasthigh.

High Grades Sawed From Butt Logs of Immature Trees.

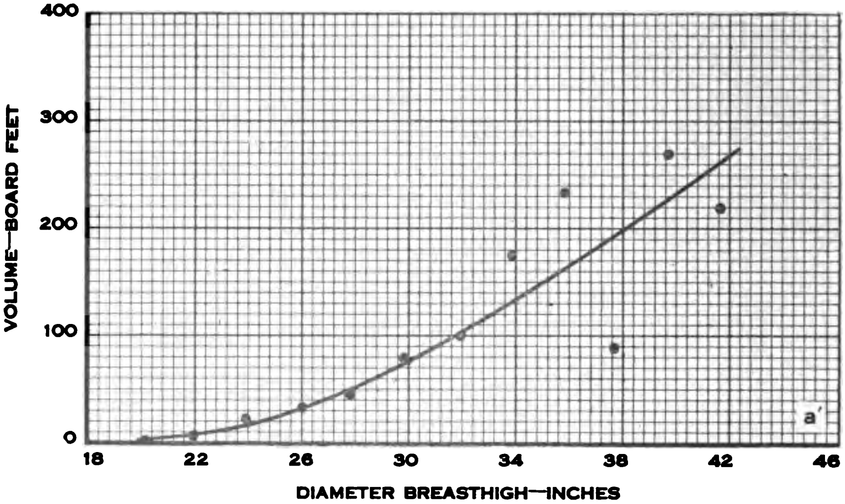

Fig. 99.—C. and Better, 6/4″.

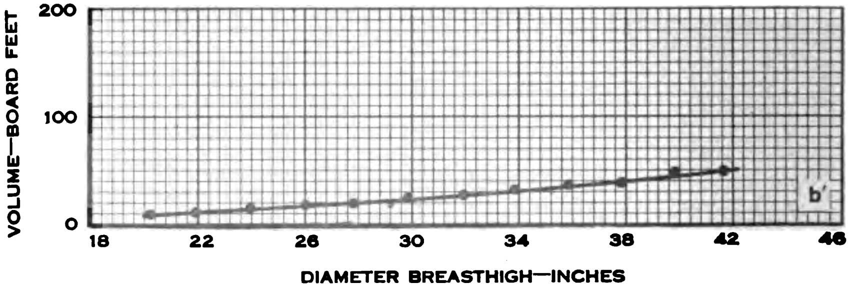

Fig. 100.—Moulding Stock.

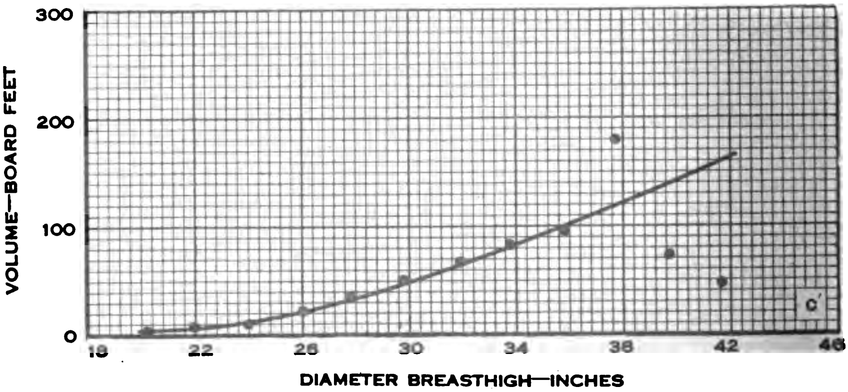

Fig. 101.—No. 1 Shop, 6/4″.

Curves showing average volume in board feet of each grade actually "sawed out" at mill, from 16′ butt logs of mature western yellow pine trees of different diameters breasthigh.

High Grades Sawed From Butt Logs of Mature Trees.

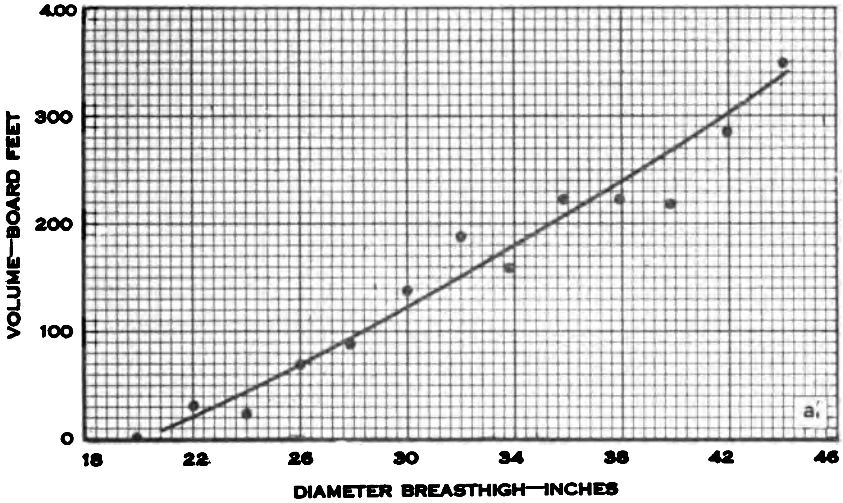

Fig. 102.—C. and Better, 6/4″.

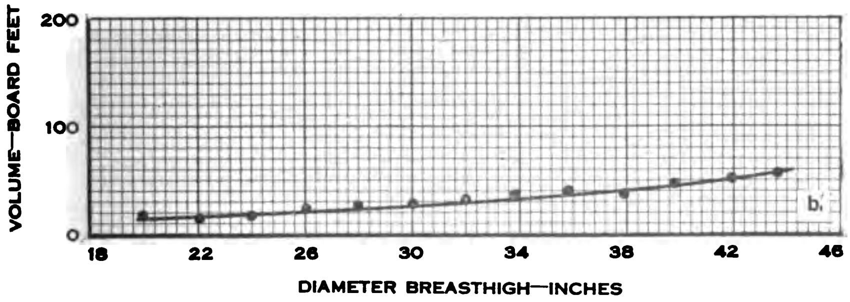

Fig. 103.—Moulding Stock.

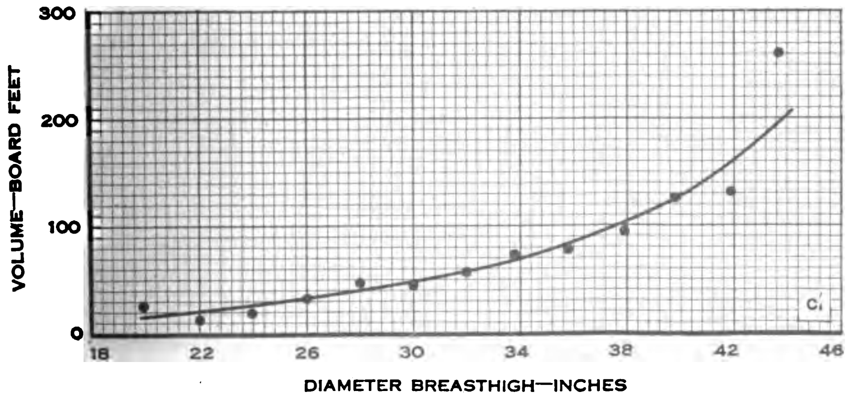

Fig. 104.—No. 1 Shop, 6/4″.

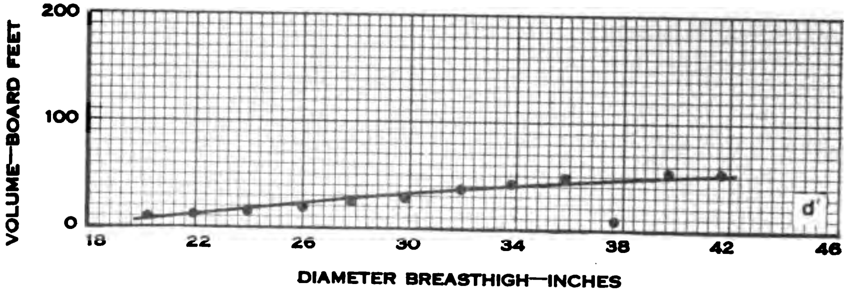

FIG. 105.—D. Select and Better, 1".

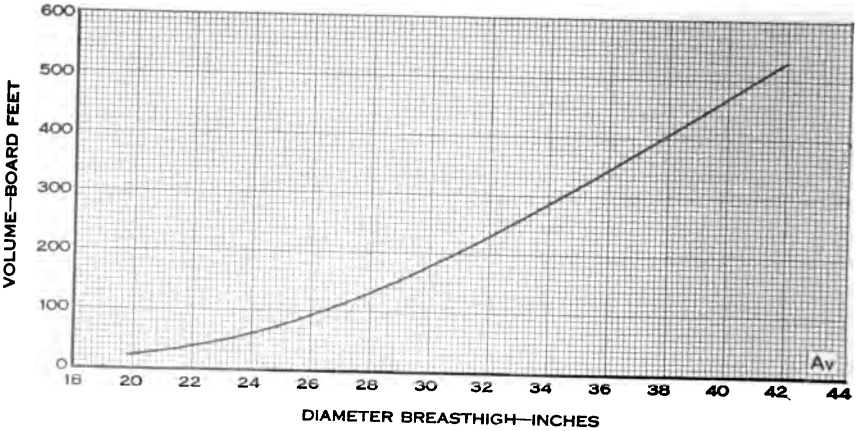

FIG. 106.—Total of high grades sawed from butt logs of immature trees.

$$a' + b' + c' + d' = Av'.$$

Intermediate Grades Sawed From Butt Logs of Immature Trees.

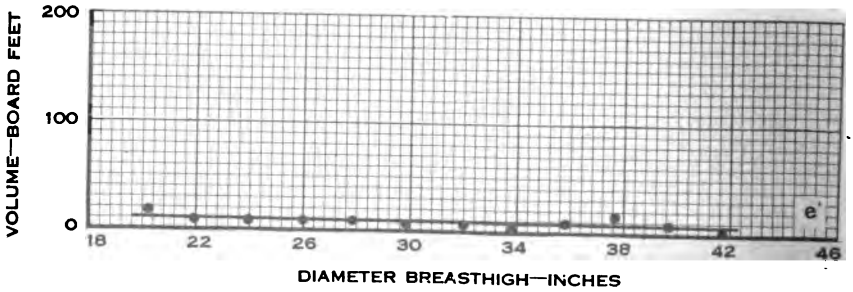

FIG. 107.—No. 1 Common, 1".

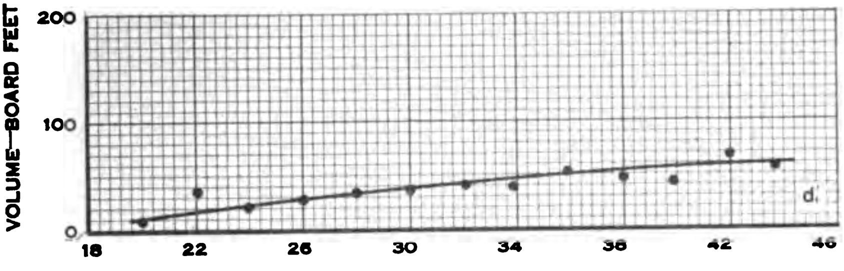

FIG. 108.—D. Select and Better, 1″.

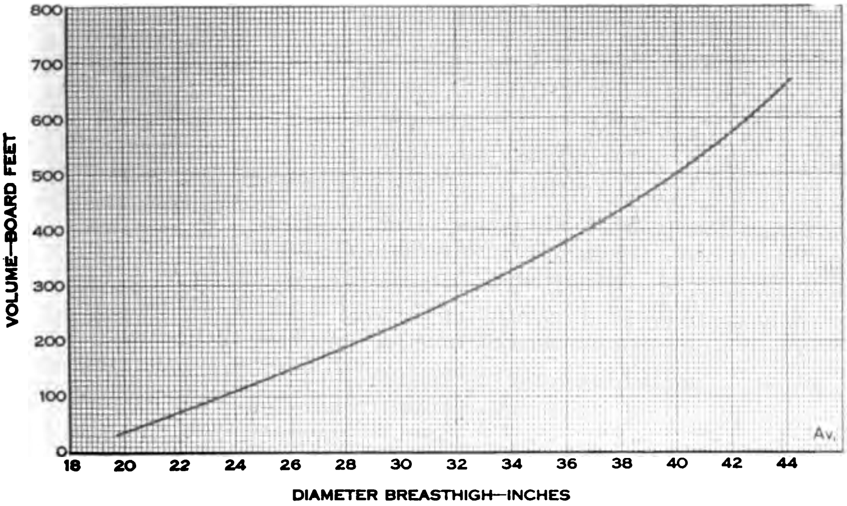

FIG. 109.—Total of high grades sawed from butt logs of mature trees.

$$a'_1 + b'_1 + c'_1 + d'_1 = Av'_1.$$

Intermediate Grades Sawed From Butt Logs of Mature Trees.

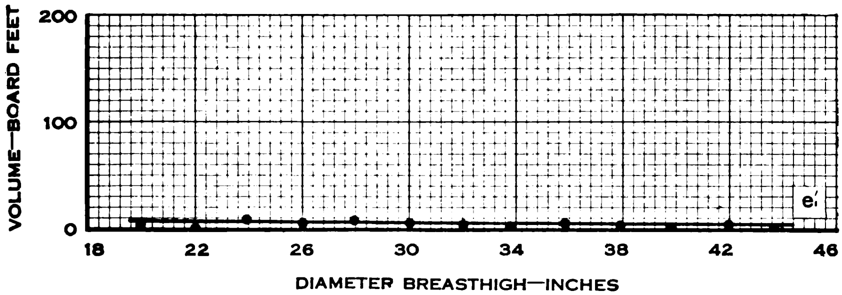

FIG. 110.—No. 1 Common, 1″.

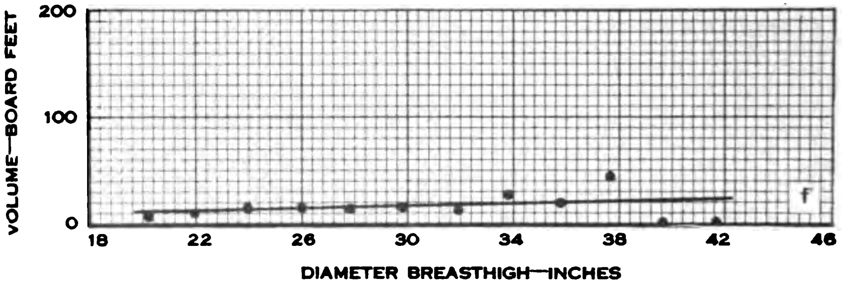

FIG. 111.—No. 2 Common, 1".

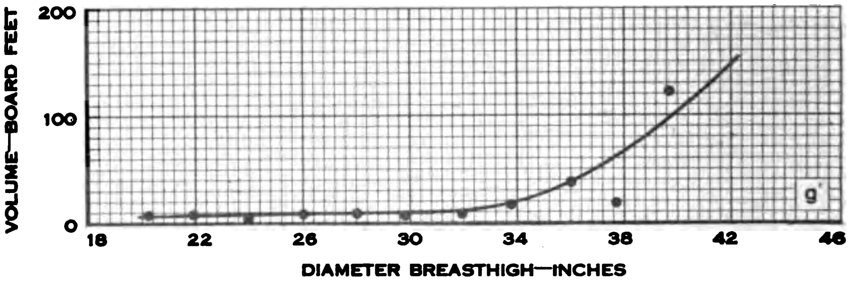

FIG. 112.—Shop 1".

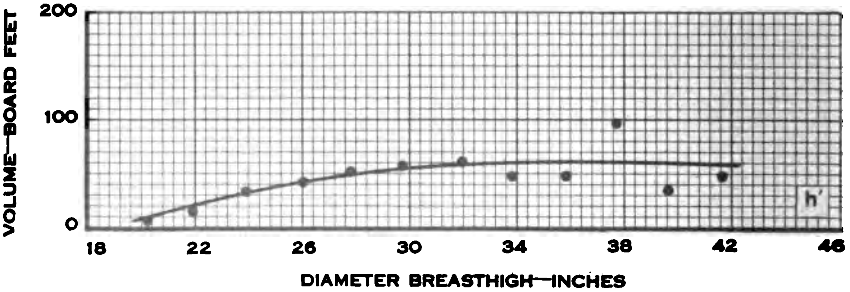

FIG. 113.—No. 2 Shop, 6/4".

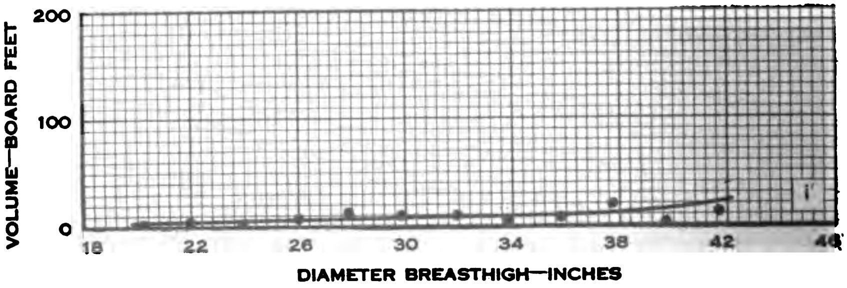

FIG. 114.—Shims.

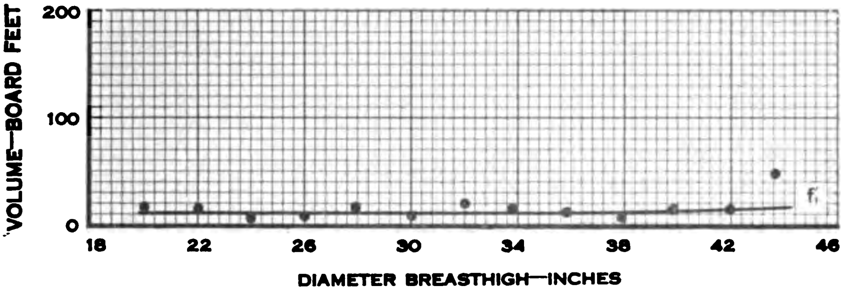

Fig. 115.—No. 2 Common, 1".

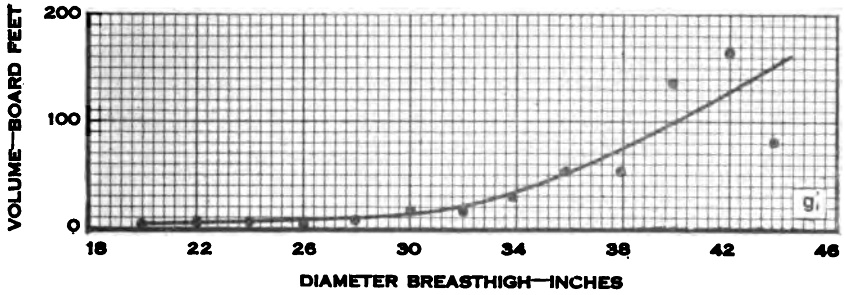

Fig. 116.—Shop 1".

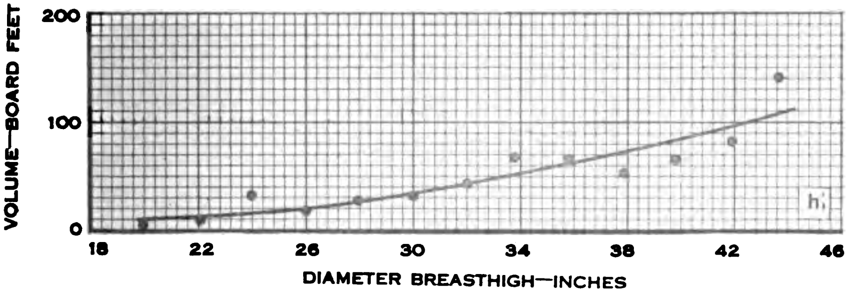

Fig. 117.—No. 2 Shop, 6/4".

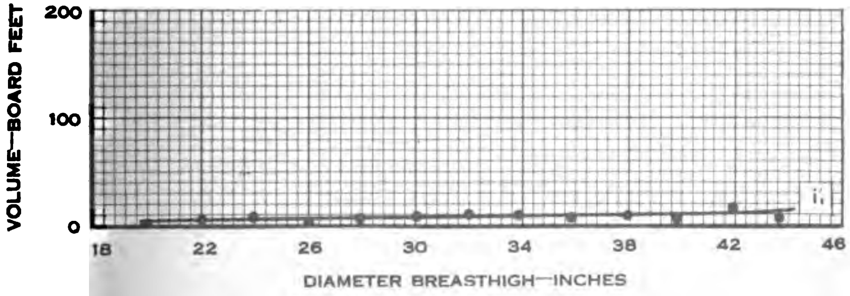

Fig. 118.—Shims.

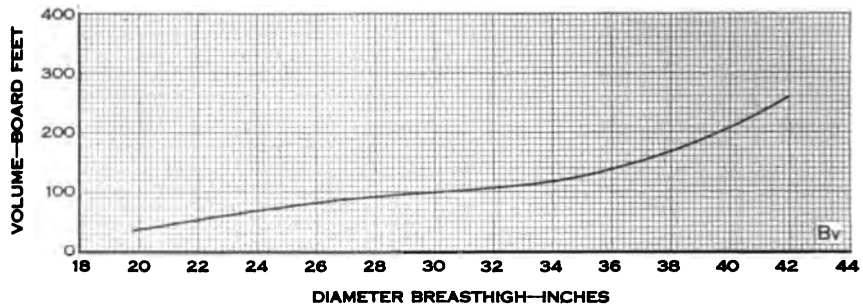

FIG. 119.—Total of intermediate grades sawed from butt logs of immature trees.

$$e' + f' + g' + h' + i' = Bv'.$$

Low Grades Sawed From Butt Logs of Immature Trees.

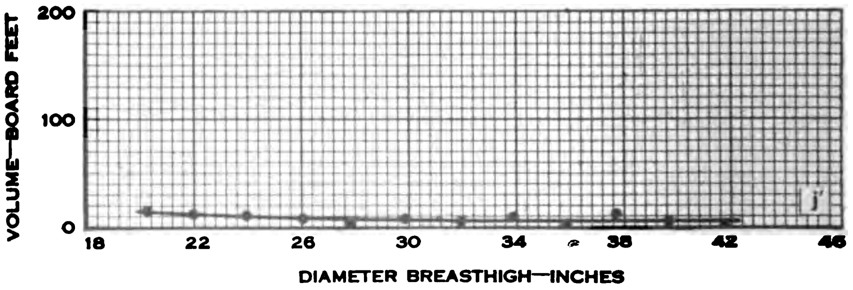

FIG. 120.—Box 1″.

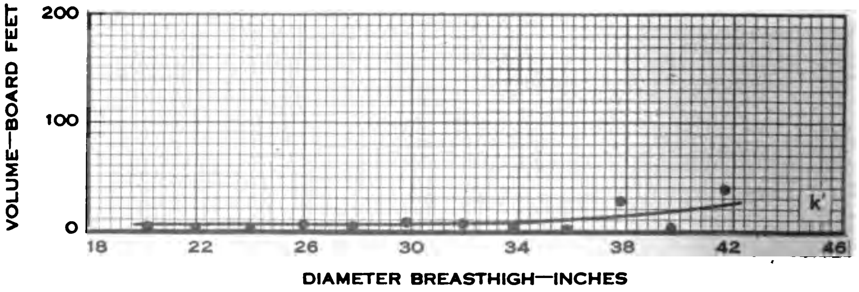

FIG. 121.—Culls.

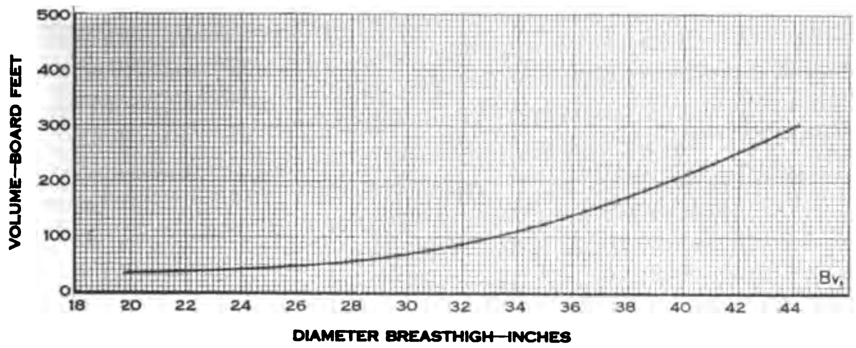

FIG. 122.—Total of intermediate grades sawed from butt logs of mature trees.

$$e'_1 + f'_1 + g'_1 + h'_1 + i'_1 = Bv'_1.$$

Low Grades Sawed From Butt Logs of Mature Trees.

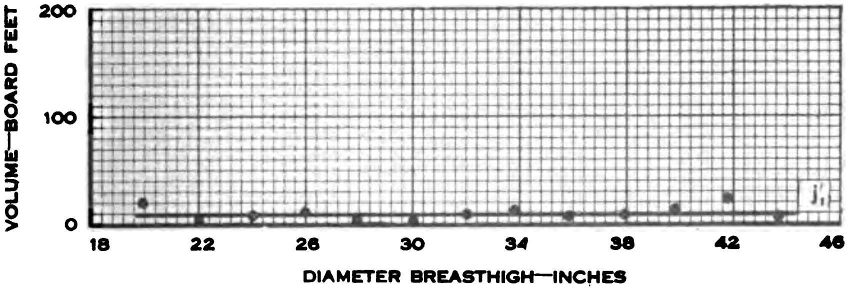

FIG. 123.—Box 1".

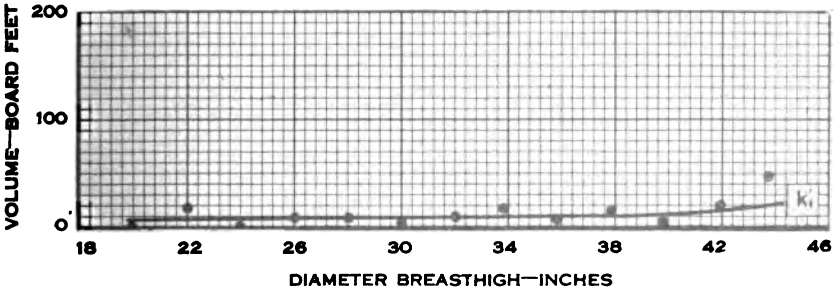

FIG. 124.—Culls.

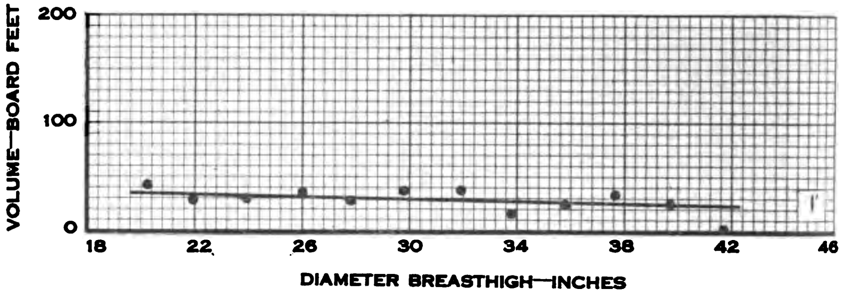

FIG. 125.—Box 6/4".

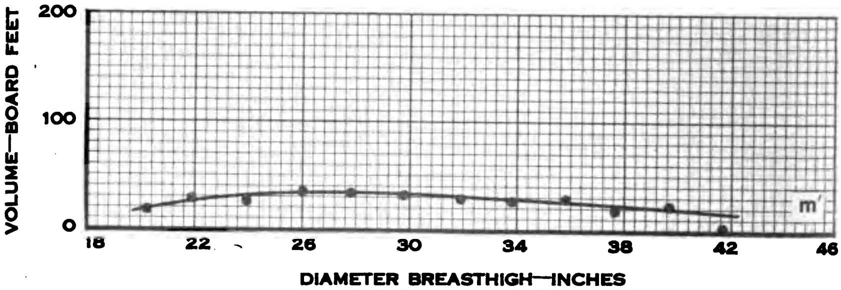

FIG. 126.—No. 3 Shop, 6/4".

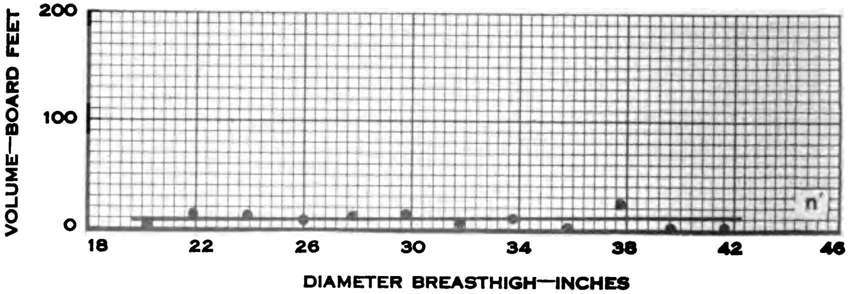

FIG. 127.—No. 3 Common, 1".

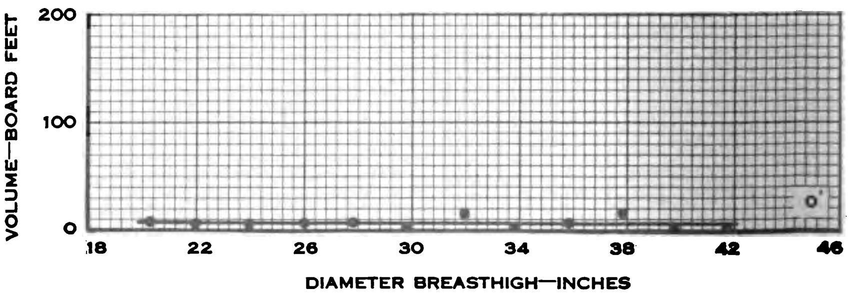

FIG. 128.—Plank 3".

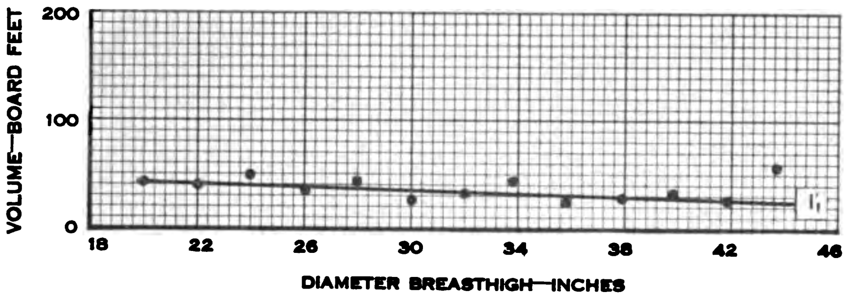

Fig. 129.—Box 6/4″.

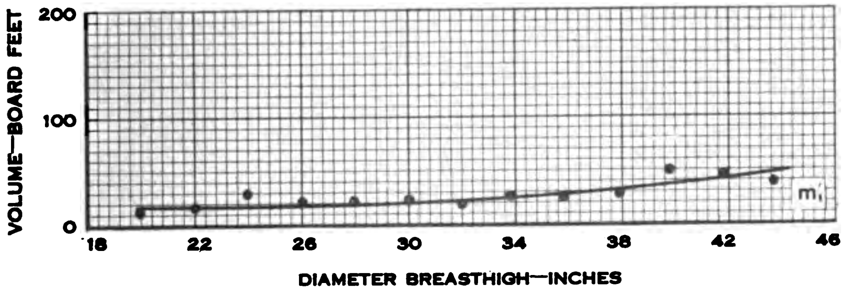

Fig. 130.—No. 3 Shop, 6/4″.

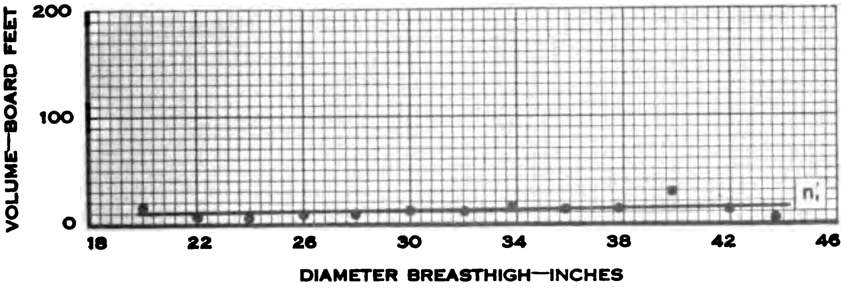

Fig. 131.—No. 3 Common, 1″.

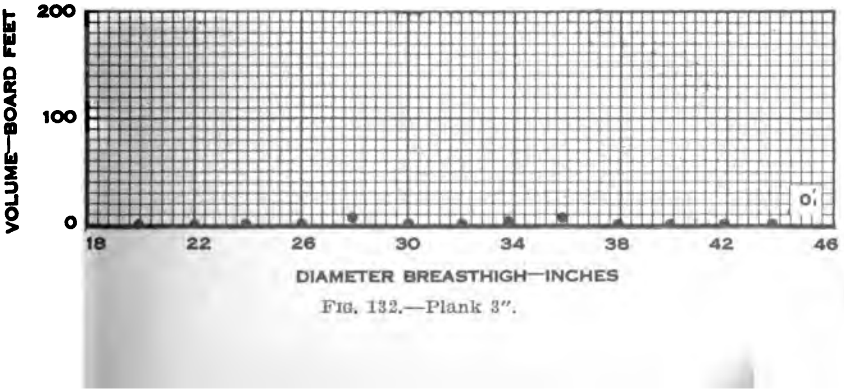

Fig. 132.—Plank 3″.

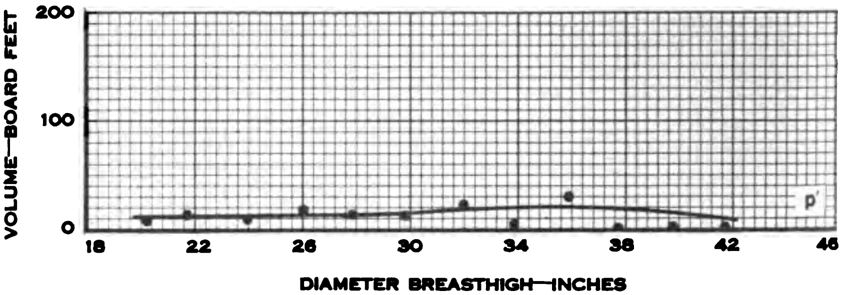

FIG. 133.—4" x 4" and Larger.

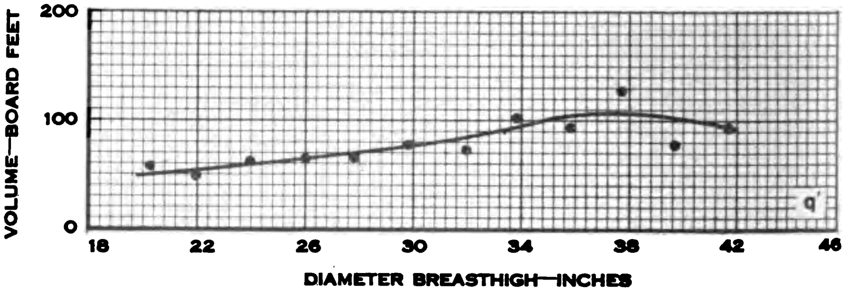

FIG. 134.—2" x 4" and Wider, No. 1 Dim.

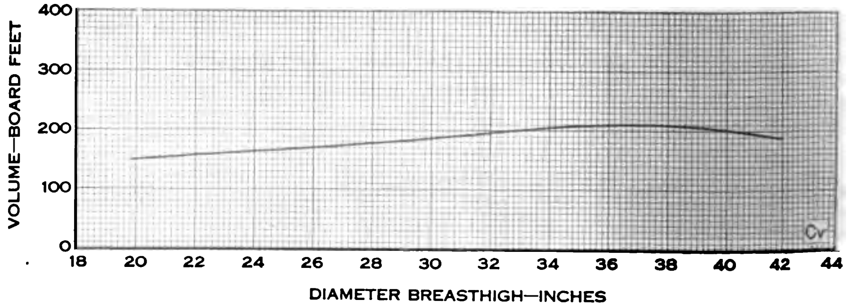

FIG. 135.—Total of low grades sawed from butt logs from immature trees.

$$j' + k' + l' + m' + n' + o' + p' + q' = Cv'.$$

NOTE.—$Av' + Bv' + Cv' = A'$ lumber actually sawed out at mill. Curve A' is shown in Fig. 97.

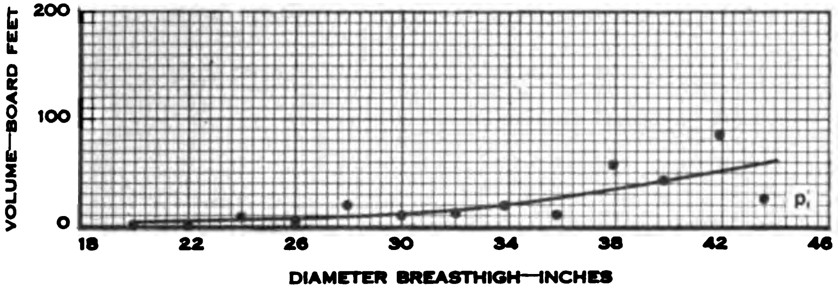

FIG. 136.—4" x 4" and Larger.

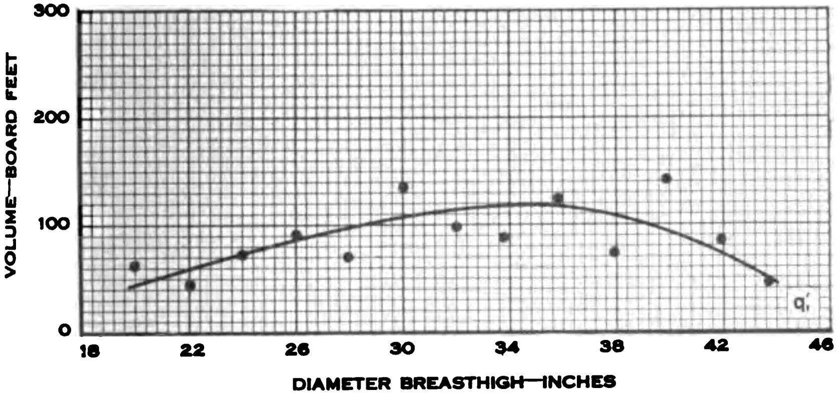

FIG. 137.—2" x 4" and Wider, No. 1 Dim.

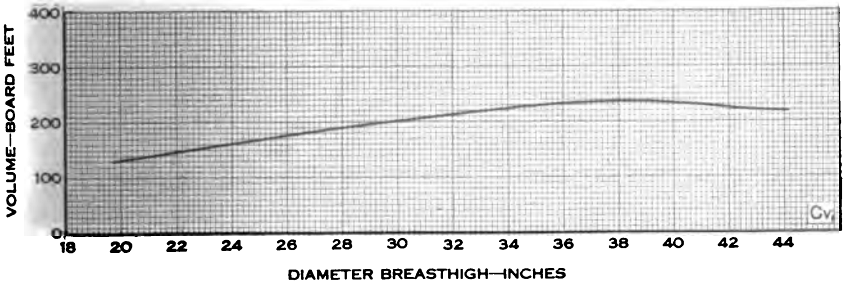

FIG. 138.—Total of low grades sawed from butt logs from mature trees.

$$j_1' + k_1' + l_1' + m_1' + n_1' + o_1' + p_1' + q_1' = Cv_1'.$$

NOTE.—$Av_1' + Bv_1' + Cv_1' = A_1'$, lumber actually sawed out at mill. Curve A_1' is shown in Fig. 98.

Grades Sawed From 16′ Butt Logs of Immature Trees of Different Diameters Breasthigh, Expressed in Per Cent of Total "Sawed Out."

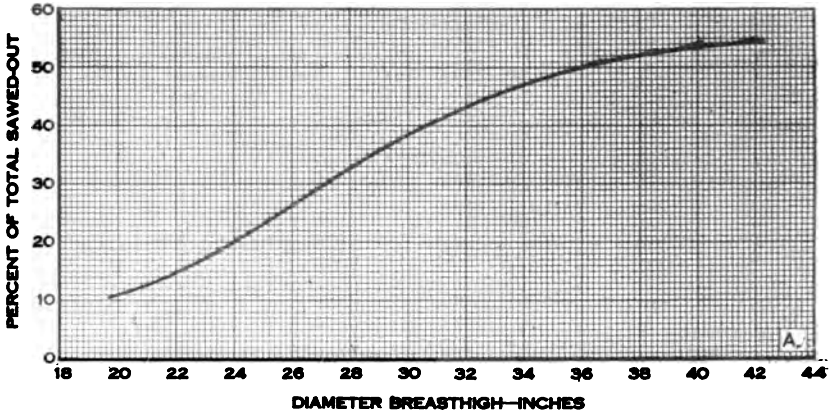

Fig. 139.—High grades. $\frac{100\,Av'}{A'} = Ap'$.

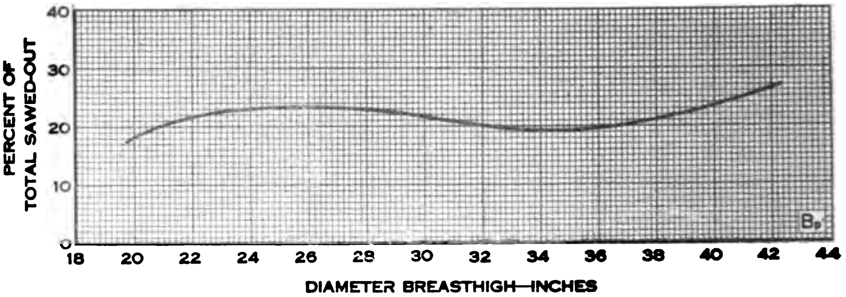

Fig. 140.—Intermediate grades. $\frac{100\,Bv'}{A'} = Bp'$.

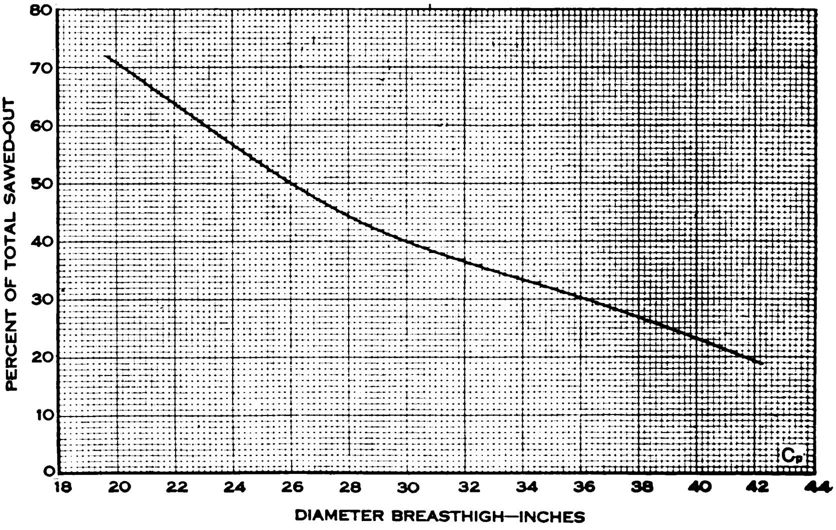

Fig. 141.—Low grades. $\frac{100\,Cv'}{A'} = Cp'$.

$$Ap' + Bp' + Cp' = 100\%.$$

Grades Sawed From 16′ Butt Logs of Mature Trees of Different Diameters Breasthigh, Expressed in Per Cent of Total "Sawed Out."

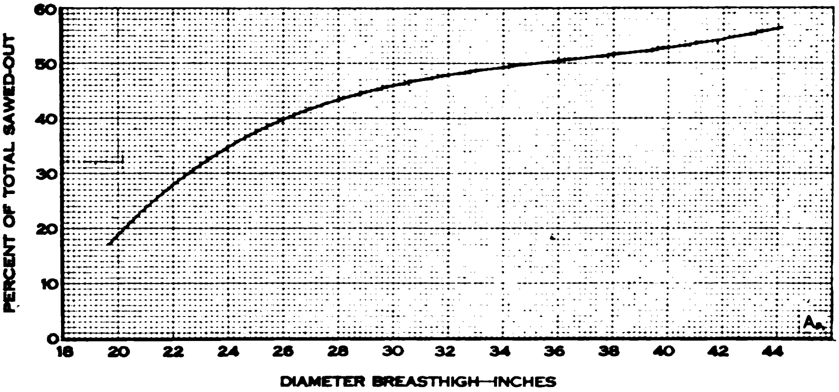

FIG. 142.—High grades. $\frac{100\,Av_1'}{A_1'} = Ap_1'$.

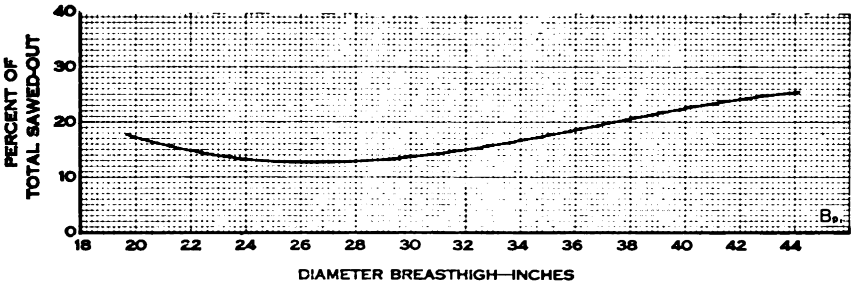

FIG. 143.—Intermediate grades. $\frac{100\,Bv_1'}{A_1'} = Bp_1'$.

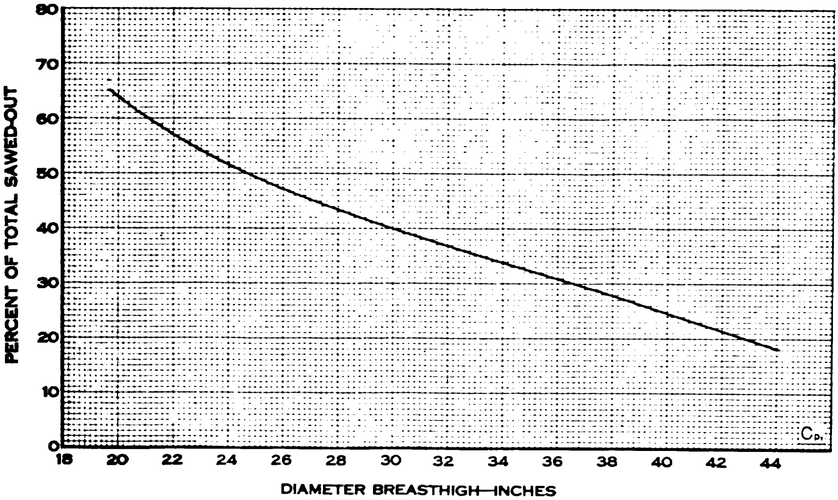

FIG. 144.—Low grades. $\frac{100\,Cv_1'}{A_1'} = Cp_1'$.

$$Ap_1' + Bp_1' + Cp_1' = 100\%.$$

Value.

Value of Grades Sawed From 16′ Butt Logs of Immature Trees of Different Diameters Breasthigh, Expressed in Dollars and Cents.

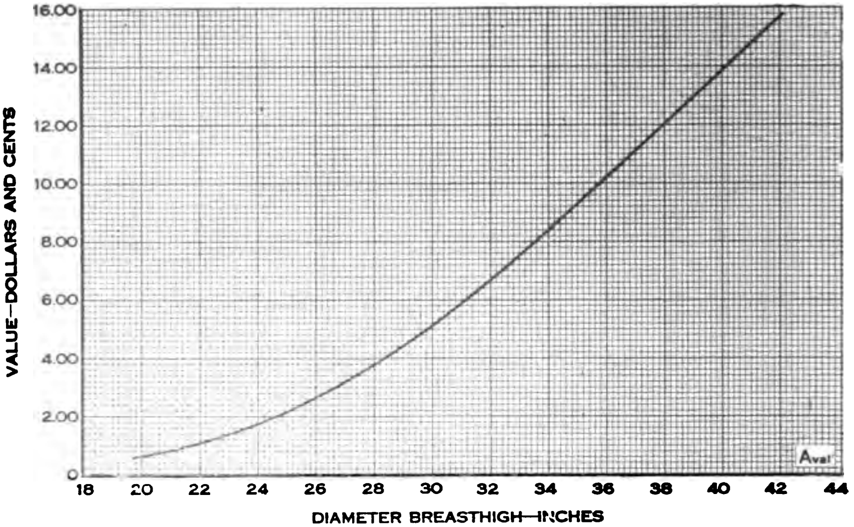

FIG. 145.—High grades.

$$.032a' + .030b' + .027c' + .025d' = Aval'.$$

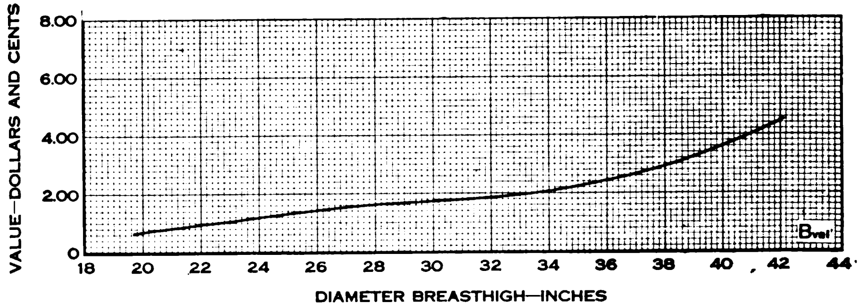

FIG. 146.—Intermediate grades.

$$.022e' + .018f' + .018g' + .018h' + .007i' = Bval'.$$

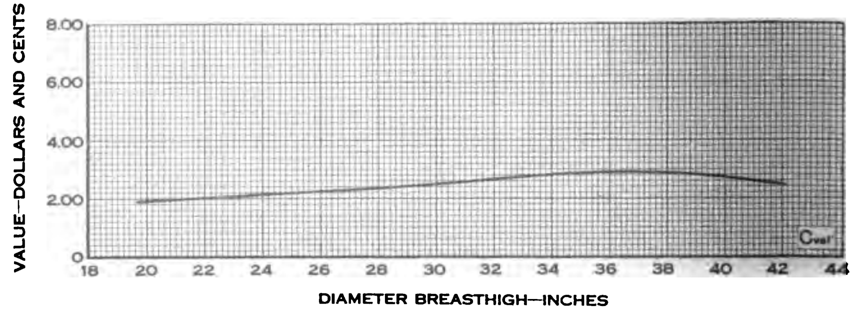

FIG. 147.—Low grades.

$$.009j' + .007k' + \_\_\_\_\_\_\_ .015q' = Cval'.$$

$$Aval' + Bval' + Cval' = B' = \text{Value per butt log.}$$

Value of Grades Sawed From 16′ Butt Logs of Mature Trees of Different Diameters Breasthigh, Expressed in Dollars and Cents.

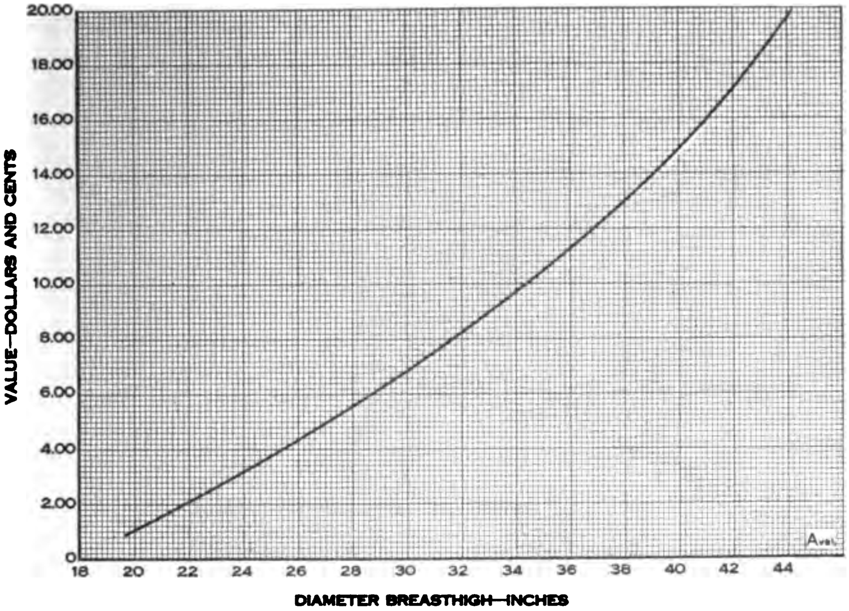

Fig. 148.—High grades.

$$.032a_1' + .030b_1' + .027c_1' + .025d_1' = Aval_1'.$$

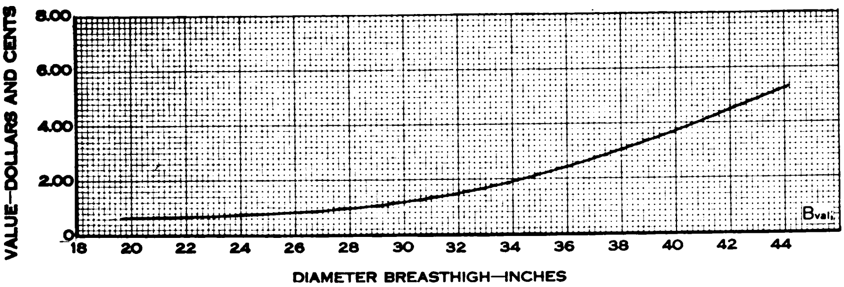

Fig. 149.—Intermediate grades.

$$.022e_1' + .018f_1' + .018g_1' + .018h_1' + .007i_1' = Bval_1'.$$

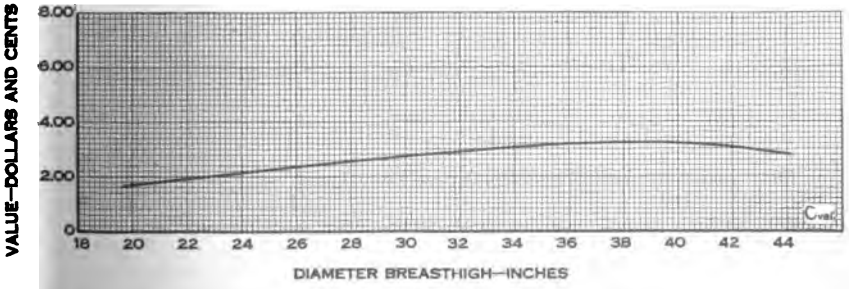

Fig. 150.—Low grades.

$$.009j_1' + .007k_1' + \text{-------} .015q_1' = Cval_1'.$$

$$Aval_1' + Bval_1' + Cval_1' = B_1' = \text{Value per butt log.}$$

FOR TOP LOGS.

Volume.

Curves showing average volume in board feet of each grade actually "sawed out" at mill, from top logs of immature western yellow pine trees of different diameters breasthigh.

High Grades Sawed From Top Logs of Immature Trees.

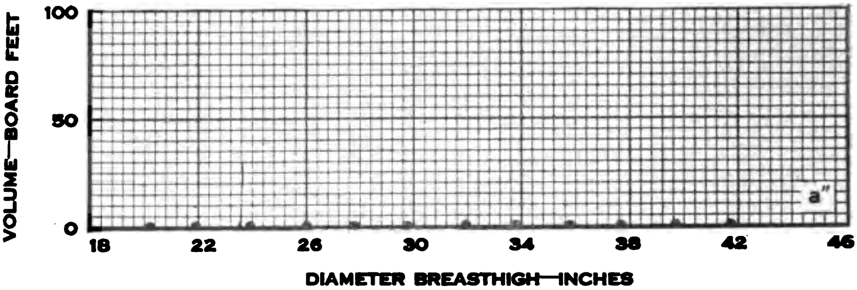

FIG. 151.—C. and Better, 6/4".

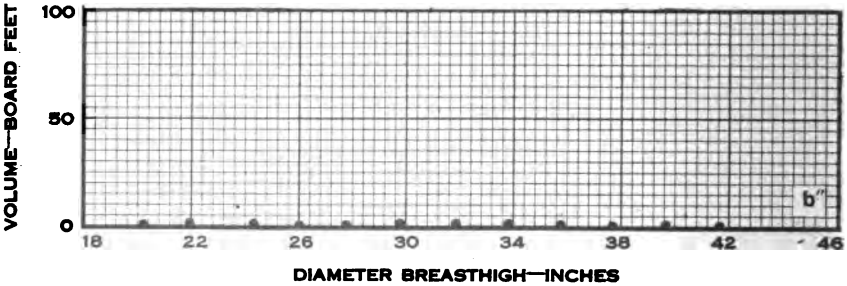

FIG. 152.—Moulding Stock.

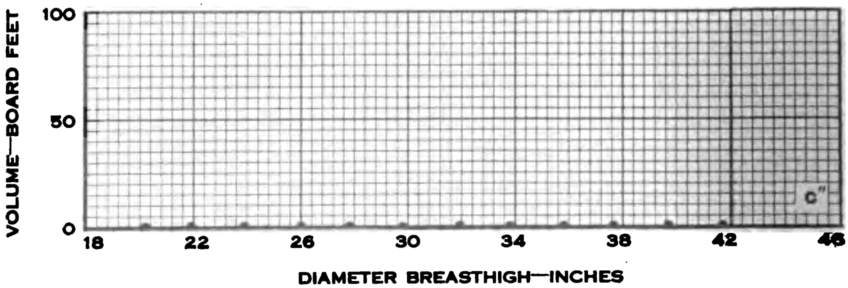

FIG. 153.—No. 1 Shop, 6/4".

Curves showing average volume in board feet of each grade actually "sawed out" at mill, from top logs of mature western yellow pine trees of different diameters breasthigh.

High Grades Sawed From Top Logs of Mature Trees.

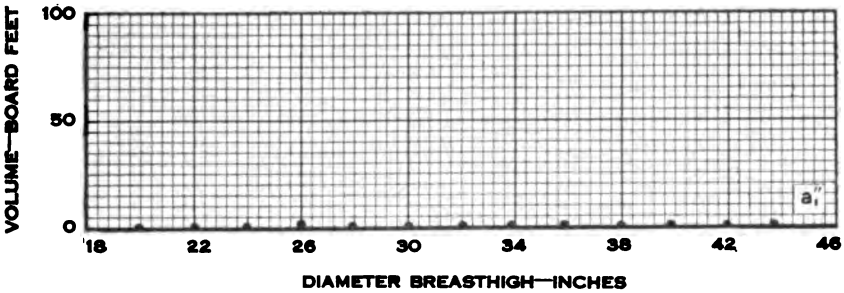

FIG. 154.—C. and Better, 6/4″.

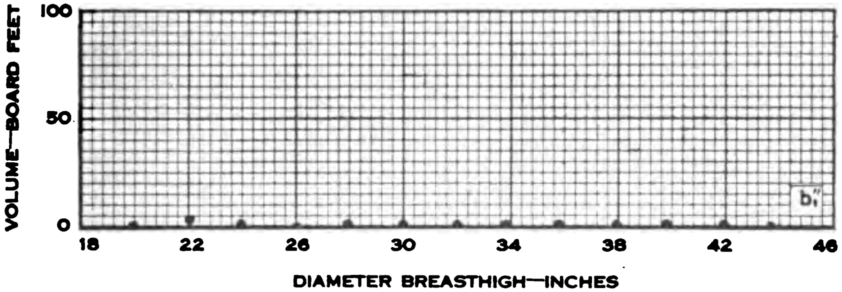

FIG. 155.—Moulding Stock.

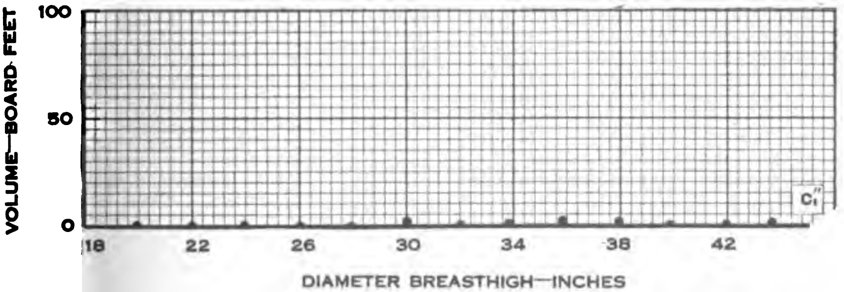

FIG. 156.—No. 1 Shop, 6/4″.

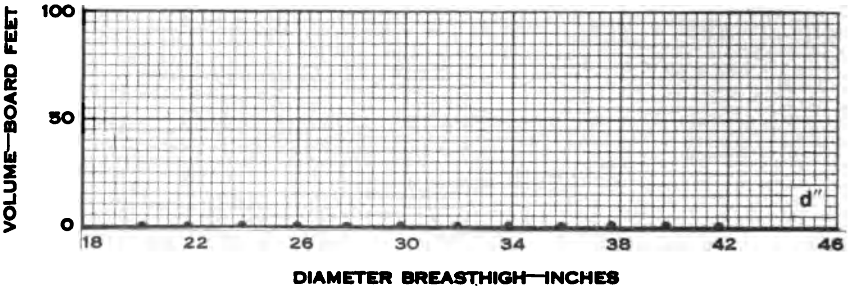

FIG. 157.—D. Select and Better, 1″.

Intermediate Grades Sawed From Top Logs of Immature Trees.

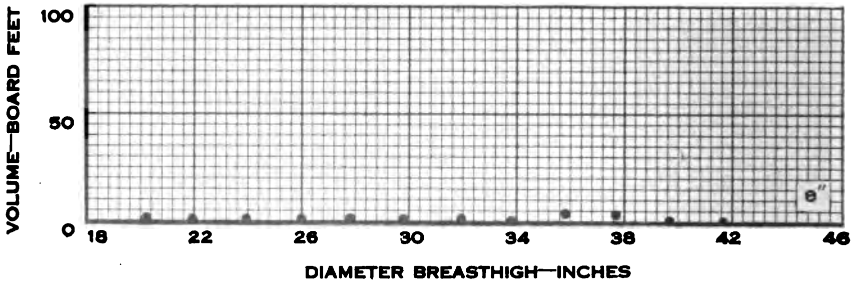

FIG. 158.—No. 1 Common, 1″.

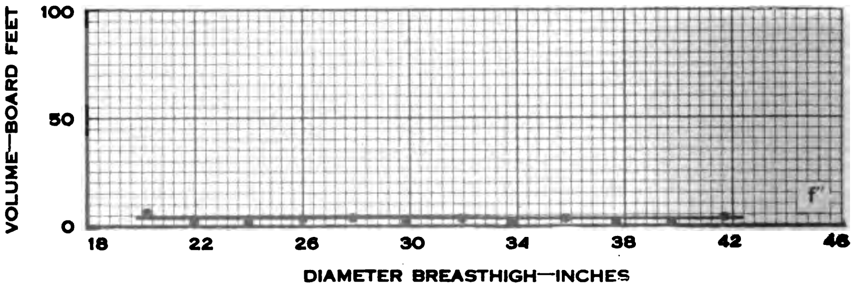

FIG. 159.—No. 2 Common, 1″.

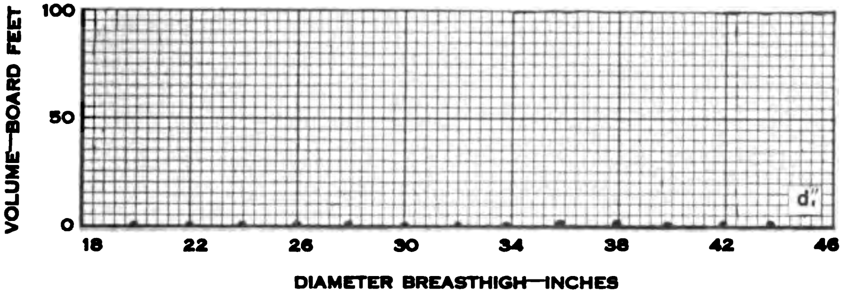

FIG. 160.—D. Select and Better, 1".

Intermediate Grades Sawed From Top Logs of Mature Trees.

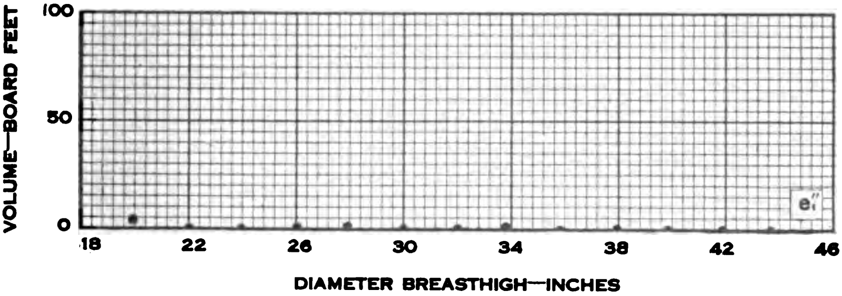

FIG. 161.—No. 1 Common, 1".

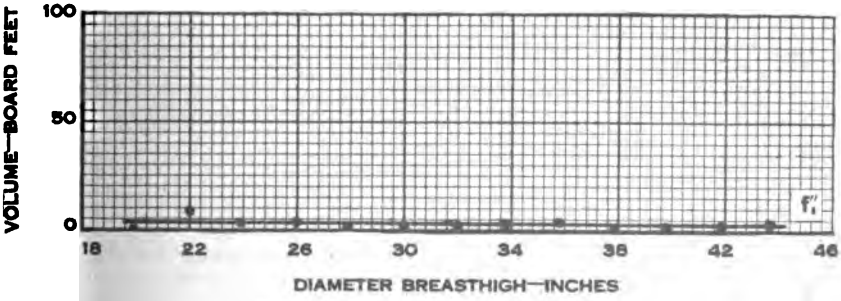

FIG. 162.—No. 2 Common, 1".

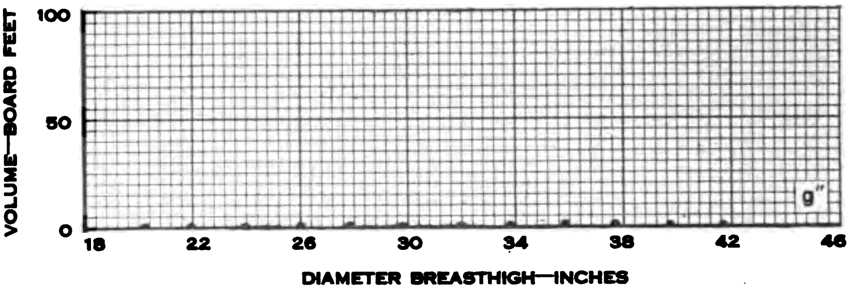

FIG. 163.—Shop, 1''.

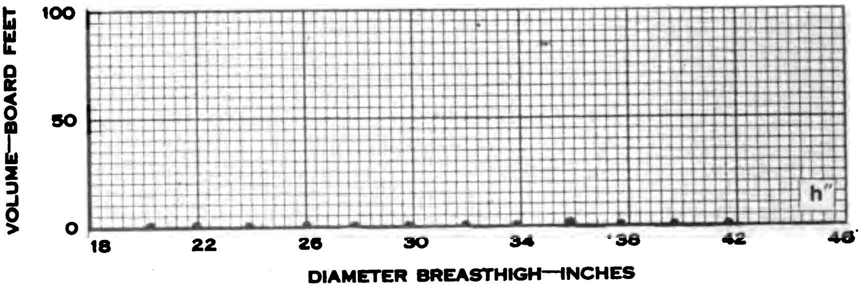

FIG. 164.—No. 2 Shop, 6/4''.

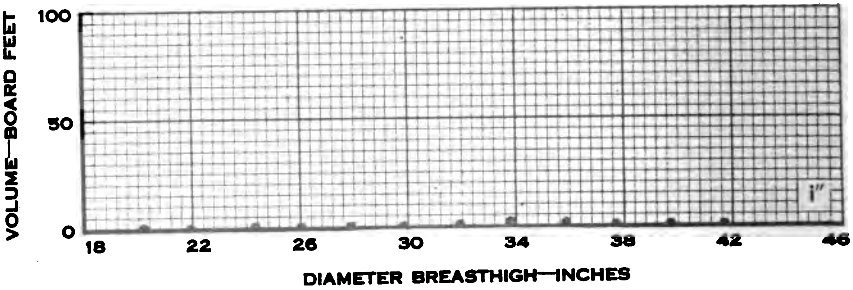

FIG. 165.—Shims.

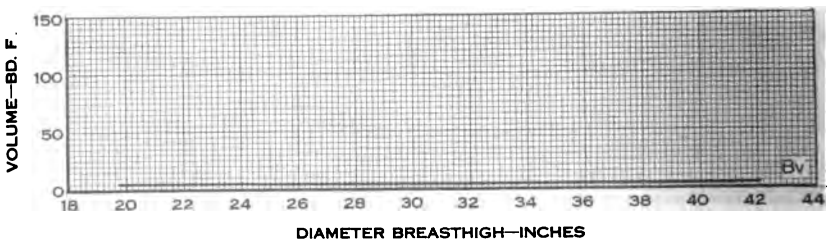

FIG. 166.—Total of intermediate grades sawed from top logs of immature trees.

$$e'' + f'' + g'' + h'' + i'' = Bv''.$$

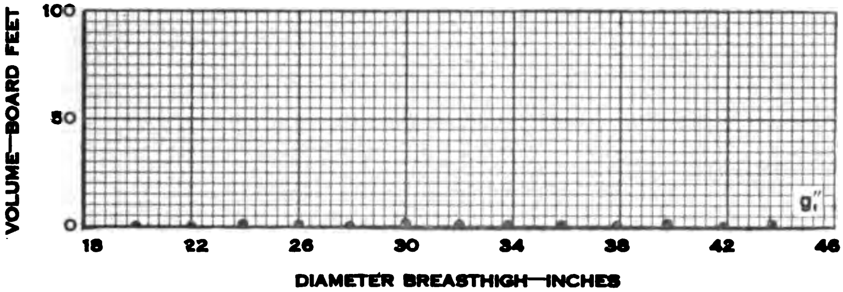

FIG. 167.—Shop, 1".

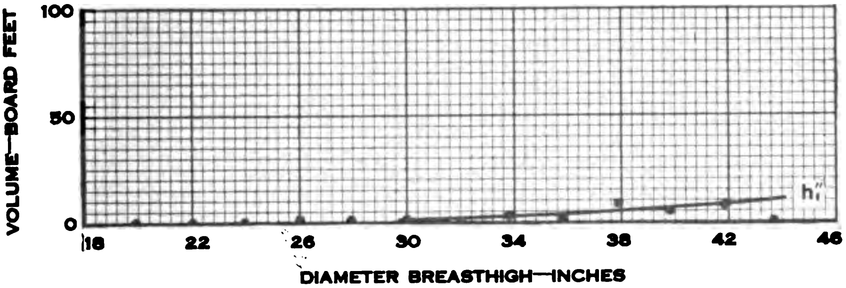

FIG. 168—No. 2 Shop, 6/4".

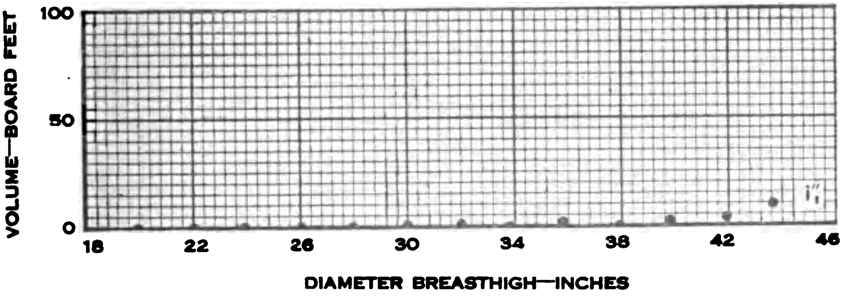

FIG. 169.—Shims.

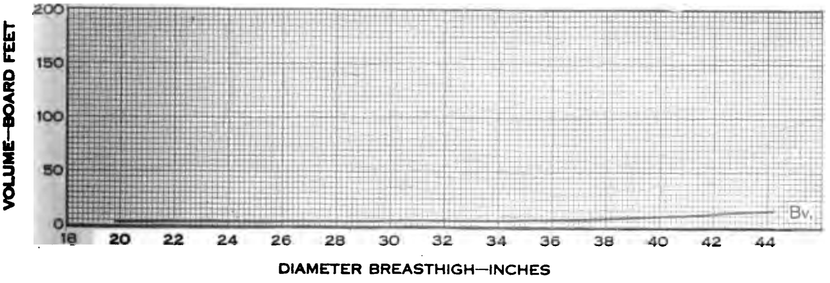

FIG. 170.—Total of intermediate grades sawed from top logs of mature trees.

$$e_1'' + f_1'' + g_1'' + h_1'' + i_1'' = Bv_1''.$$

Low Grades Sawed From Top Logs of Immature Trees.

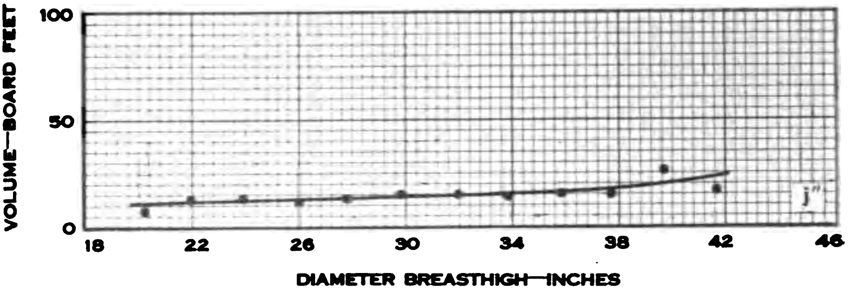

FIG. 171.—Box 1''.

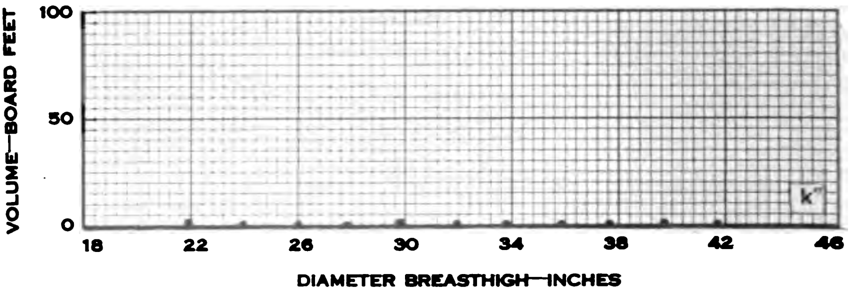

FIG. 172.—Culls.

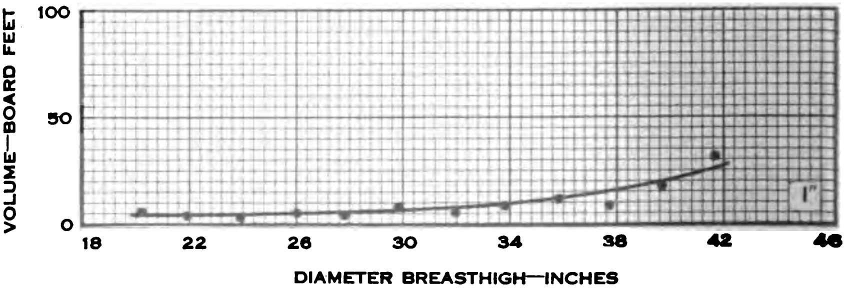

FIG. 173.—Box, 6/4''.

Low Grades Sawed From Top Logs of Mature Trees.

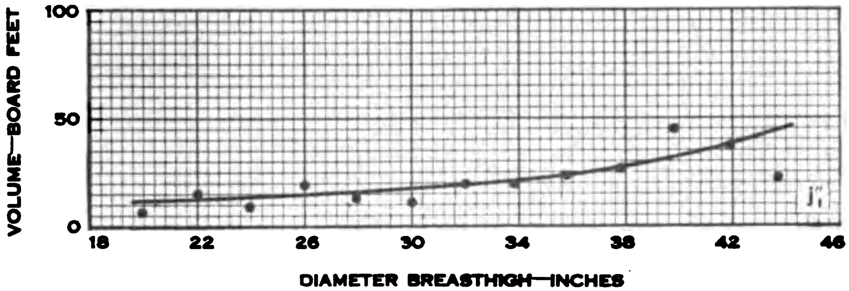

FIG. 174.—Box 1".

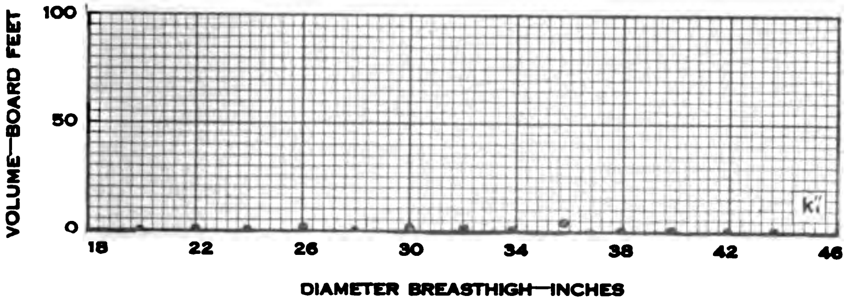

FIG. 175.—Culls.

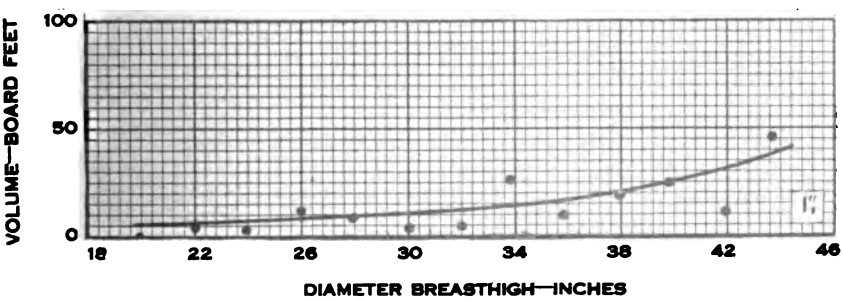

FIG. 176.—Box, 6/4".

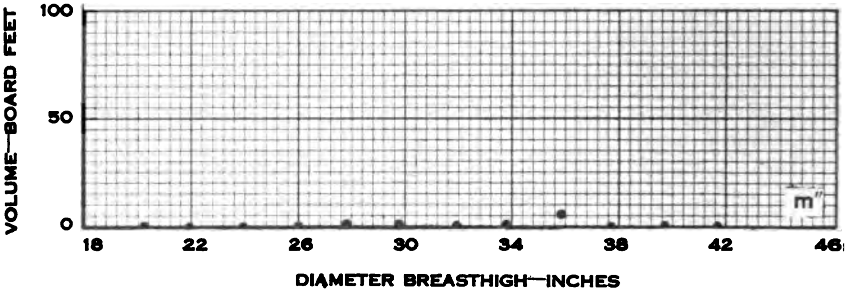

FIG. 177.—No. 3 Shop, 6/4″.

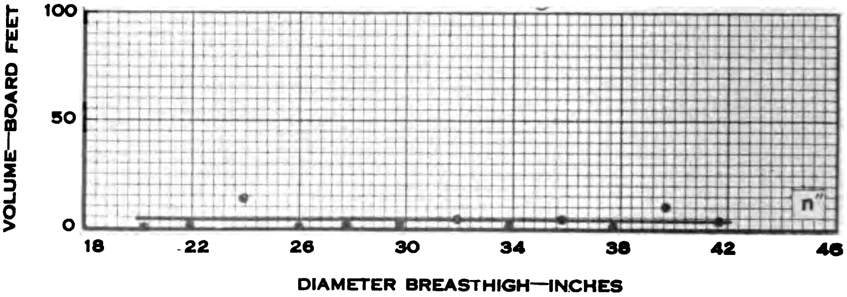

FIG. 178.—No. 3 Common, 1″.

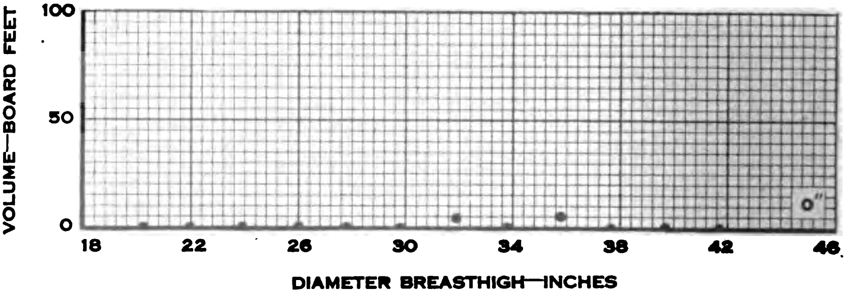

FIG. 179.—Plank, 3″.

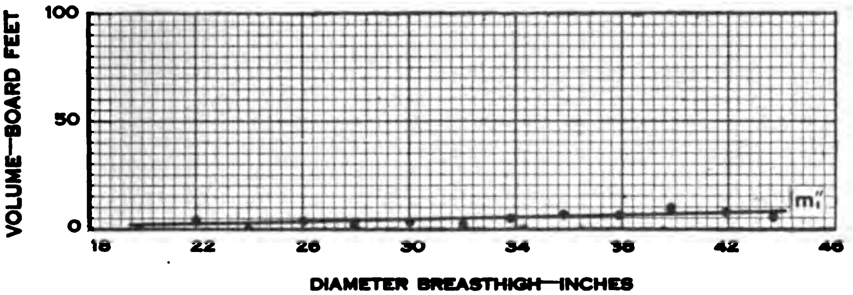

FIG. 180.—No. 3 Shop, 6/4".

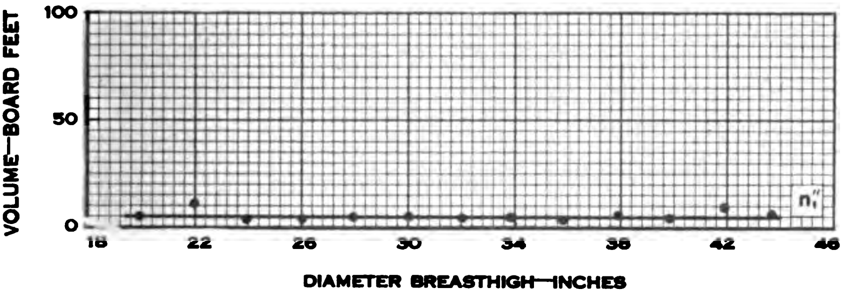

FIG. 181.—No. 3 Common, 1".

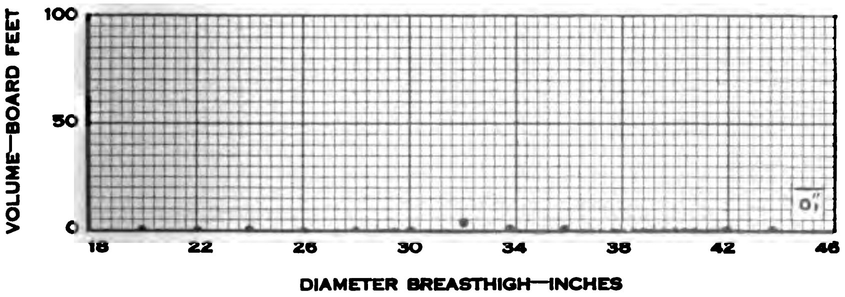

FIG. 182.—Plank, 3".

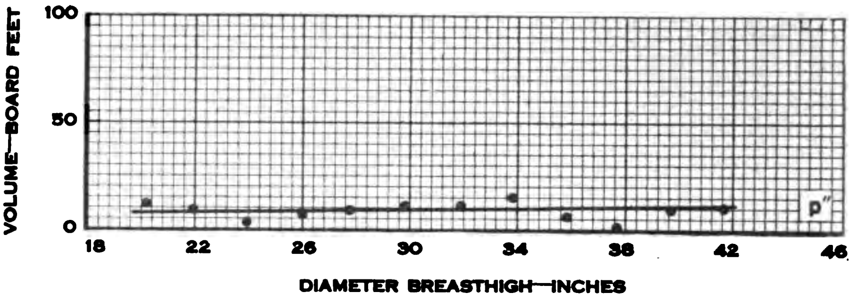

FIG. 183.—4" x 4" and Larger.

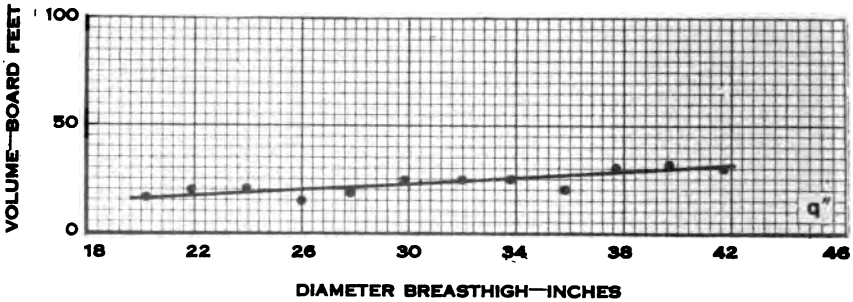

FIG. 184.—2" x 4" and Wider, No. 1 Dim.

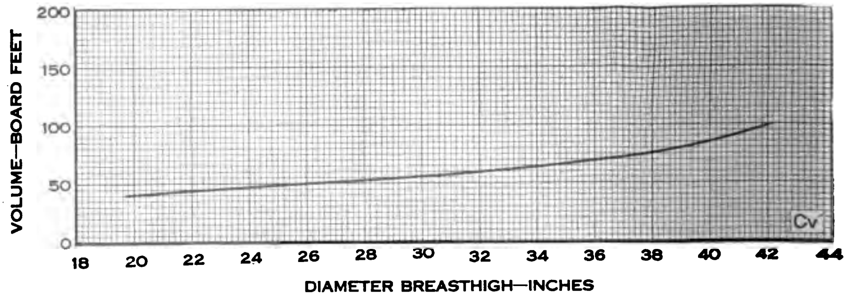

FIG. 185.—Total of low grades sawed from top logs of immature trees.

$$j'' + k'' + l'' + m'' + n'' + o'' + p'' + q'' = Cv''.$$

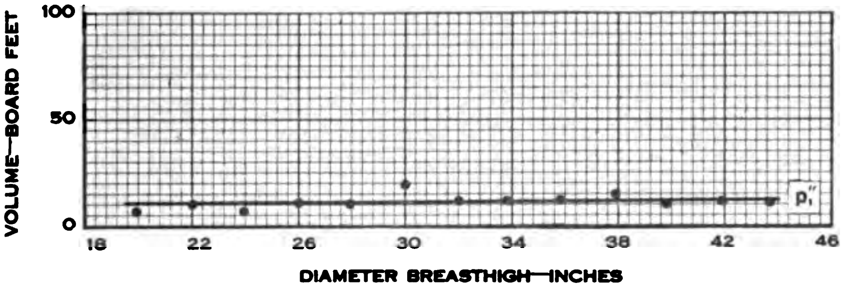

FIG. 186.—4" x 4" and Larger.

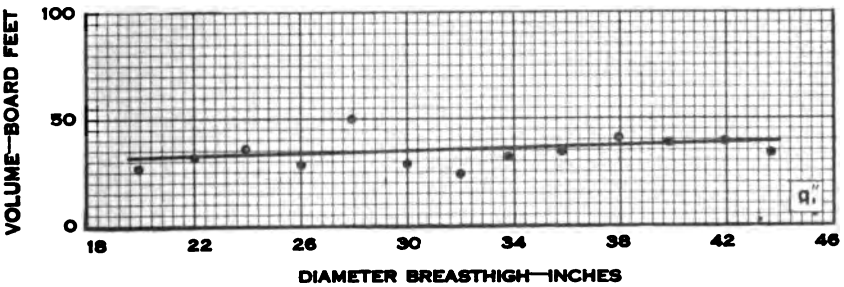

FIG. 187.—2" x 4" and Wider, No. 1 Dim.

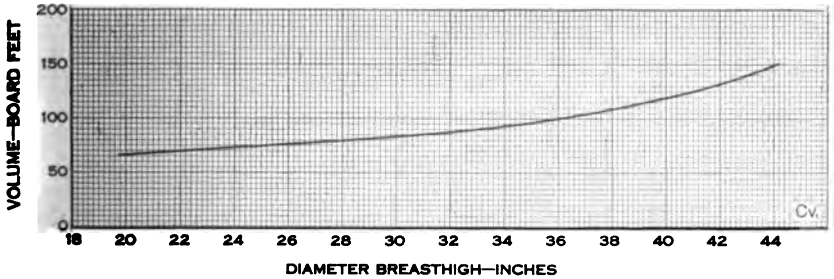

FIG. 188.—Total of low grades sawed from top logs of mature trees.

$$j_1'' + k_1'' + l_1'' + m_1'' + n_1'' + o_1'' + p_1'' + q_1'' = Cv_1''.$$

Value.

Value of Grades Sawed From Top Logs of Immature Trees of Different Diameters Breasthigh, Expressed in Dollars and Cents.

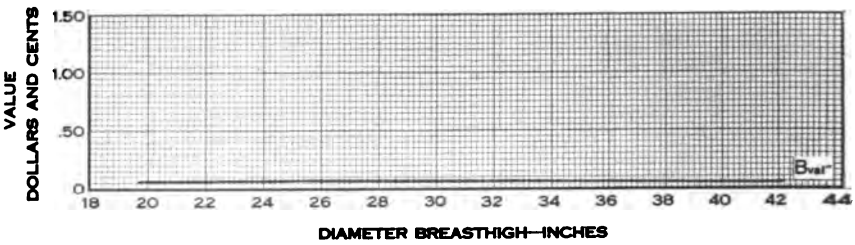

FIG. 189.—Intermediate grades.

$$.022c'' + .018f'' + .018g'' + .018h'' + .007i'' = Bval''.$$

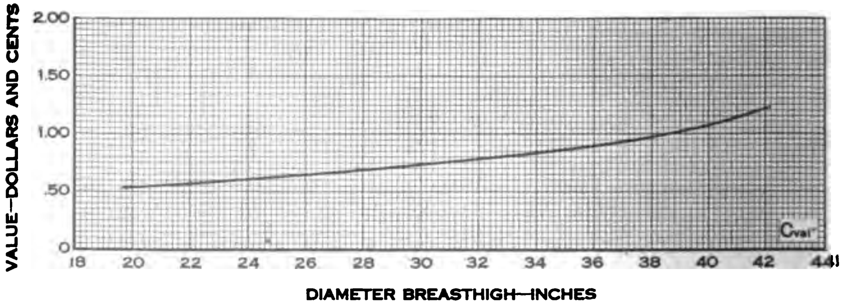

FIG. 190.—Low grades.

$$.009j'' + .007k'' + \text{-------} .015q'' = Cval''.$$
$$Aval'' + Bval'' + Cval'' = B'' = \text{Value per top log.}$$

Value of Grades Sawed From Top Logs of Mature Trees of Different Diameters Breasthigh, Expressed in Dollars and Cents.

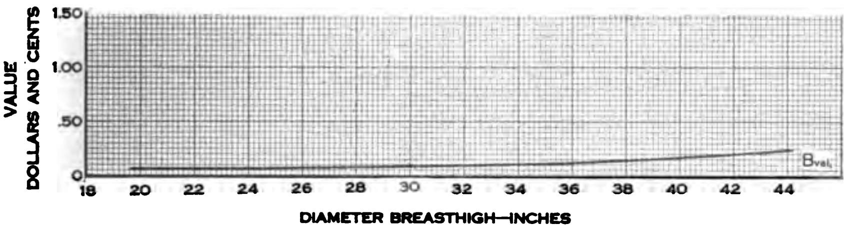

FIG. 191.—Intermediate grades.

$$.022e_1'' + .018f_1'' + .018g_1'' + .018h_1'' + .007i_1'' = Bval_1''.$$

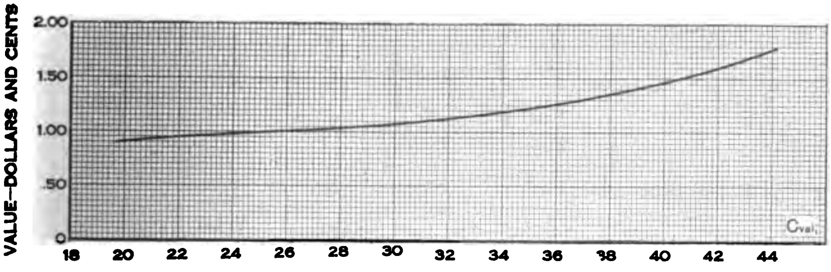

FIG. 192.—Low grades.

$$.009j_1'' + .007k_1'' + \text{-------} .015q_1'' = Cval_1''.$$

$$Aval_1'' + Bval_1'' + Cval_1'' = B_1'' = \text{Value per top log.}$$

A Comparison of Quality of Top Logs, Whole Trees, and Butt Logs.

[illegible] intermediate, and low grades, sawed [illegible] merchantable trees of different [illegible] total sawed out.

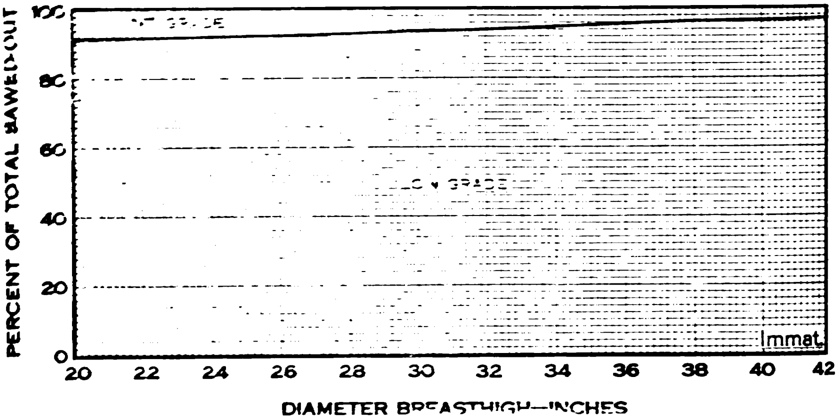

FIG. 193.—Top logs. $Ap'' + Bp'' + Cp'' = 100\%$.

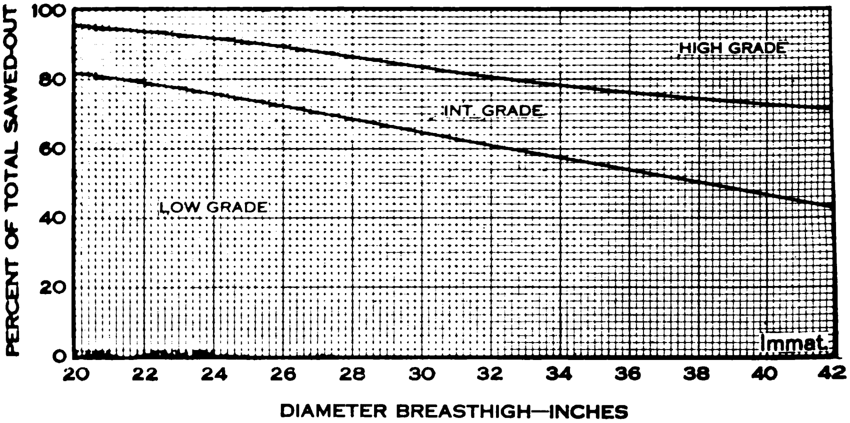

FIG. 194.—Whole trees. $Ap + Bp + Cp = 100\%$.

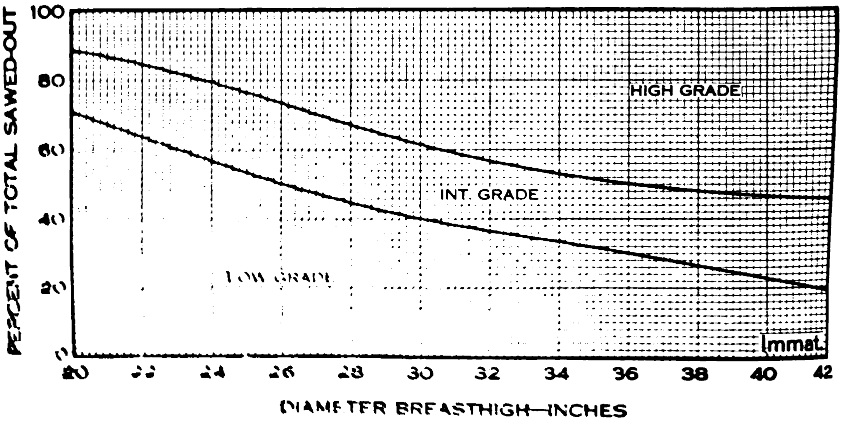

FIG. 195.—Butt logs. $Ap' + Bp' + Cp' = 100\%$.

Diagrams showing the high, intermediate, and low grades, sawed from top logs, whole trees, and butt logs, of mature trees of different diameters breasthigh, expressed in per cent of total sawed out.

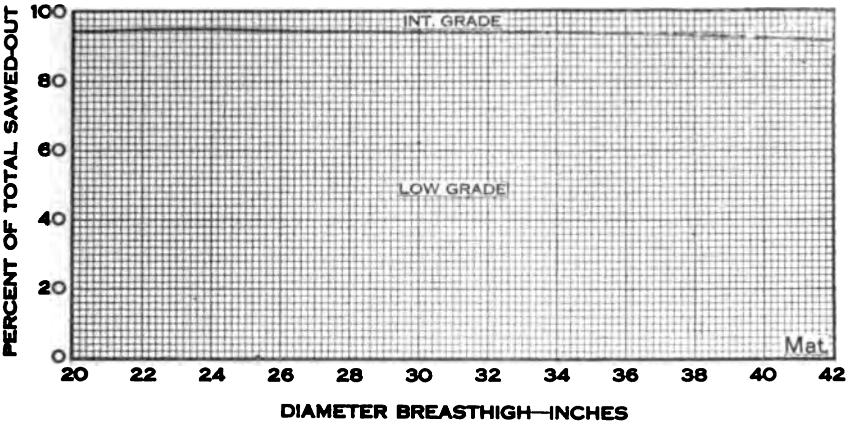

FIG. 196.—Top logs. $Ap_1'' + Bp_1'' + Cp_1'' = 100\%$.

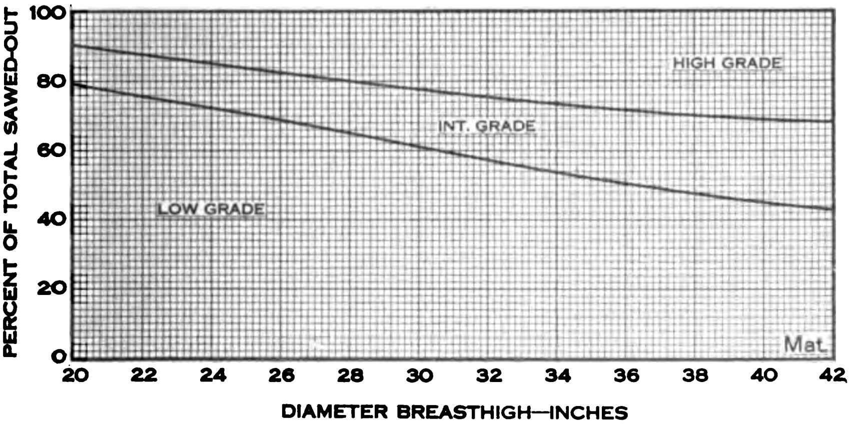

FIG. 197.—Whole trees. $Ap_1 + Bp_1 + Cp_1 = 100\%$.

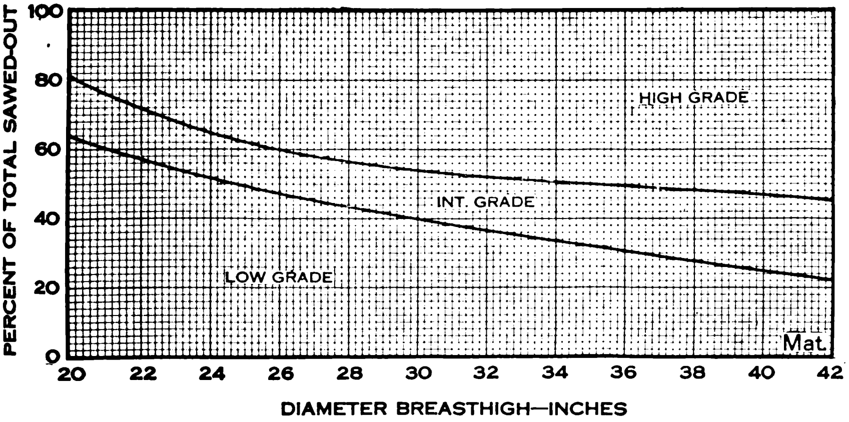

FIG. 198.—Butt logs. $Ap_1' + Bp_1' + Cp_1' = 100\%$.

MILL OVER-RUN.

"Mill over-run" is the difference between the total sawed out volume in board feet and the volume in board feet as indicated by a given log rule, when the former is greater than the latter. Should the total sawed out volume be less than the volume indicated by the log rule, the difference would then be called a "mill under-run."

It is usually customary to express a mill over-run, or under-run, in per cent of volume as indicated by the log rule used. For example: If a log scales 800 board feet and saws out 1000 board feet, the mill over-run is 25%. If it scales 1000 board feet and saws out 800 board feet, the under-run is 20%. If it scales 800 and saws out 800, then it is said to "hold up the scale"; over-run in this case being 0%.

The Spaulding Log Rule, which is the statute rule of California, was used by the Red River Lumber Company in Lassen County, where the field work of this study was conducted, and the following comparisons of total sawed out and log scale are based upon volume indicated by that rule.

In Fig. 199 the average volume in board feet, sawed out at the mill from immature trees of different diameters breasthigh, is shown by Curve A; the average volume for the same trees, as indicated by the Spaulding Log Rule, is shown by Curve As, and the difference between these average curves, which is Curve O, is the average mill over-run from immature trees of different sizes. $(A - As = O)$.

Fig. 200 shows the mill over-run as indicated by Curve O, expressed in per cent of volume in board feet; that is,

$$\frac{100(A - As)}{As} = \frac{100\,O}{As} = Op = \%\ \text{Mill over-run.}$$

Figs. 201 and 202 show similar determinations made for mature yellow pine.

It will be observed that the per cent mill over-run for both immature and mature trees is exceedingly high, and that it is higher for the immature than for the mature, and higher for small trees than for large ones. In Figs. 204 and 206 the same general tendencies will be seen along with the striking feature that these determinations run lower than the ones for whole trees.

These differences are brought about by the log rule used and by local practices in vogue at the mill.

The Spaulding Log Rule, to begin with, has an enormous waste allowance for small logs, which is over 130% of the volume allowed for manufactured product. This allowance becomes smaller as the size of the log in question becomes larger, and approaches 36.5% for very large logs. Such a waste allowance is too large for small logs, even in cases where 36.5% for large logs is about right.

The wastage from small logs should, however, be greater than for large ones, but not three or four times as great, as the Spaulding Log Rule allows. This is why the per cent of mill over-run shown in Figs. 199, 200, 204, and 206 is greater for small diameters than for large ones. It also explains why the per cent over-run for whole trees is much greater than for 16′ but logs from the same trees. The smaller the log the greater the per cent over-run; therefore, a tree 20″ in diameter breasthigh which contains four logs in the merchantable length, three of which are of course smaller than the butt log, has, as a whole, a larger per cent over-run than does the butt log alone. Mature trees and butt logs from them show a lower per cent over-run than do immature trees and butt logs from immature trees of corresponding diameters. The fact that the Spaulding Log Rule is not a level one is also indirectly the cause of this. Mature trees have a thinner bark than the immature, therefore a 16′ butt log from a mature tree of a given diameter breasthigh has a greater diameter inside the bark than a butt log of the same length coming from an immature tree of the same diameter breasthigh. The larger the logs the lower the per cent over-run; hence, the difference between Figs. 204 and 206.

The differences in Figs. 200 and 202 are brought about by thickness of bark together with form of bole. Mature trees show a higher form factor than the immature; they are filled out more, the taper being very slight in the first three or four 16′ logs. The effect of high form factors, or fullness of bole, tends to decrease the per cent of mill over-run.

In Fig. 207 a comparison of per cent over-run for butt logs and whole trees, of immature western yellow pine, is shown, while in Fig. 208 a similar comparison is made for mature trees and 16′ butt logs from them. It will be observed that there is at least 23% over-run in all cases, regardless of size of log or tree. This difference between actual cut at the mill and the Spaulding Log Rule is easily accounted for, since the Spaulding rule was constructed for a thick saw, and since some of the lumber sawed was cut shy on dimensions, and that clear, straight grained edgings were usually graded as moulding stock.

NOTE.—During the season of 1915 it was learned that the company had discontinued the practice of cutting shy on dimensions.

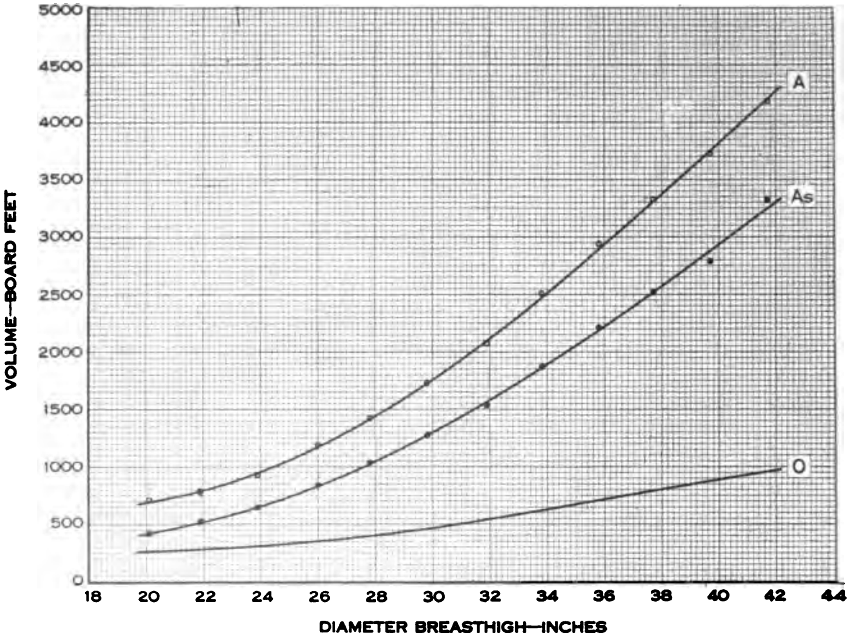

FIG. 199.—Curves showing "mill over-run" for immature trees of different diameters breasthigh. A = Volume in board feet actually sawed out at mill. As = Volume in board feet as shown by the Spaulding Log Rule. O = "Mill over-run" = A — As.

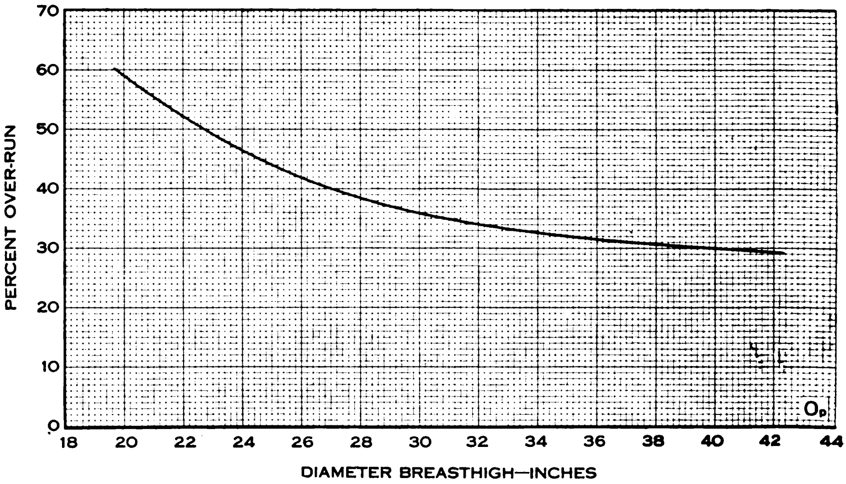

FIG. 200.—Curve showing per cent of "mill over-run" for immature trees.

$$\frac{100\,(A - As)}{As} = \frac{100\,O}{As} = Op.$$

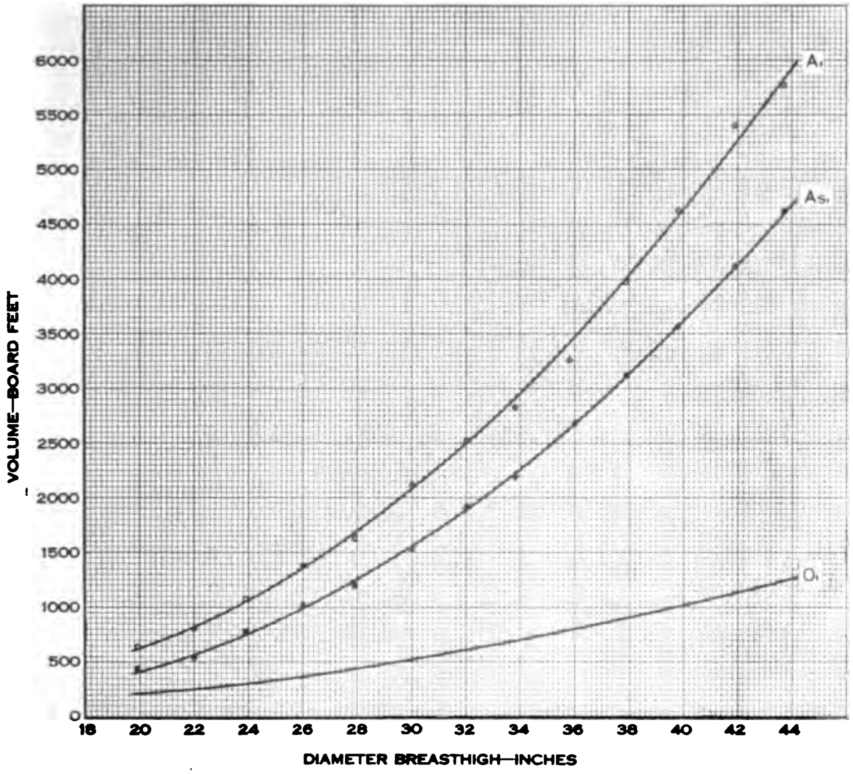

FIG. 201.—Curves showing "mill over-run" for mature trees of different diameters breasthigh. A_1 = Volume in board feet actually sawed out at mill. As_1 = Volume in board feet as shown by the Spaulding Log Rule. O_1 = "Mill over-run" = $A_1 - As_1$.

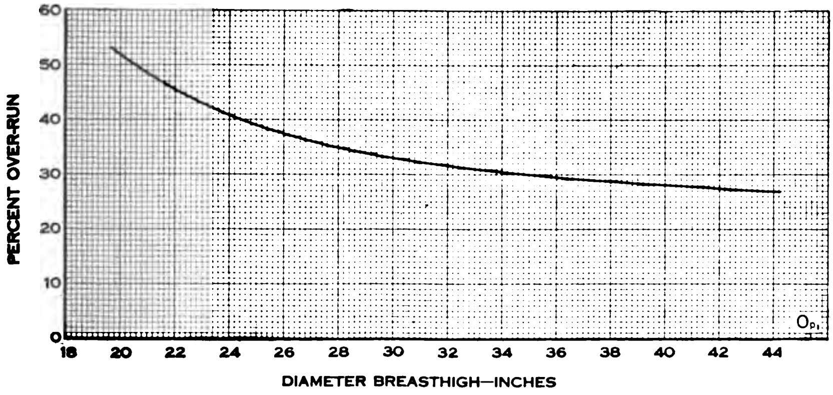

FIG. 202.—Curve showing per cent of "mill over-run" for mature trees.

$$\frac{100\,(A_1 - As_1)}{As_1} = \frac{100\,O_1}{As_1} = Op_1.$$

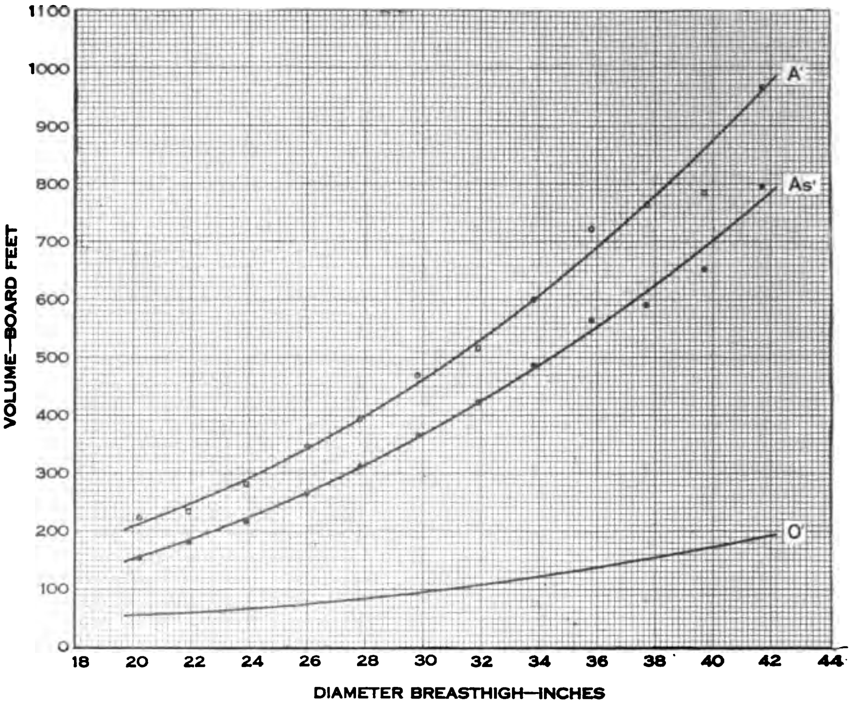

FIG. 203.—Curves showing "mill over-run" for butt logs from immature trees of different diameters breasthigh. A' = Volume in board feet actually sawed out at mill. As' = Volume in board feet as shown by the Spaulding Log Rule. O' = "Mill over-run" = A' — As'.

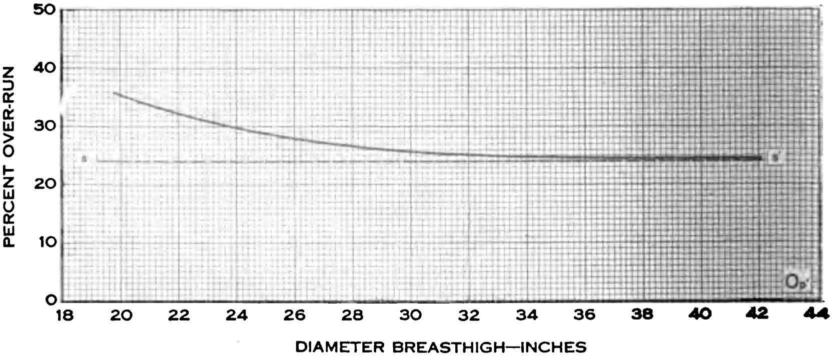

FIG. 204.—Curves showing per cent of "mill over-run" for butt logs from immature trees.

$$\frac{100\,(A' - As')}{As'} = \frac{100\,O'}{As'} = Op'.$$

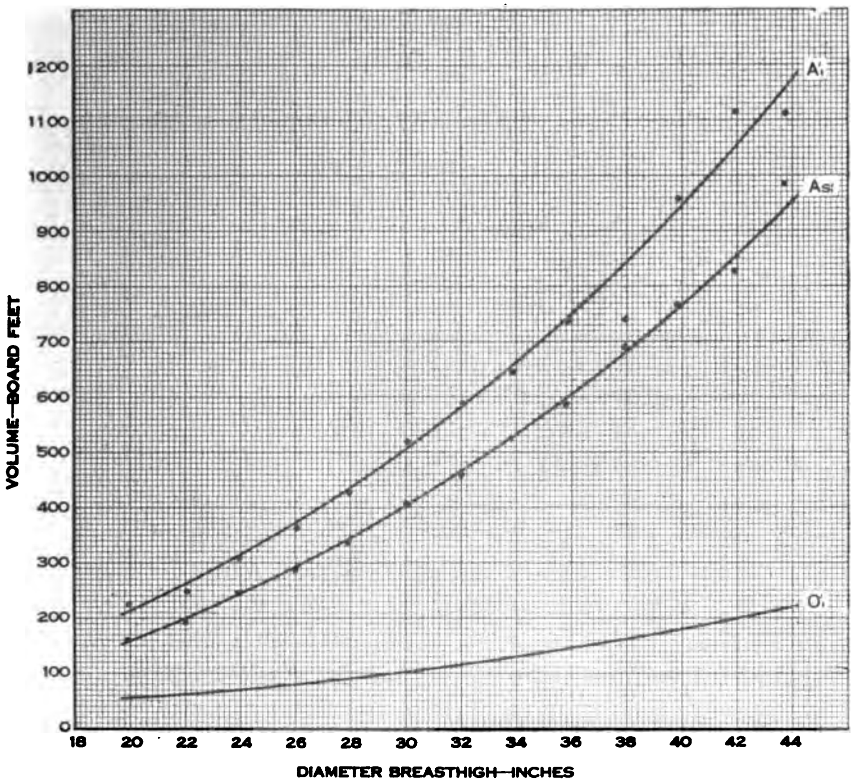

FIG. 205.—Curves showing "mill over-run" for butt logs from mature trees of different diameters breasthigh. $A_1' =$ Volume in board feet actually sawed out at mill. $As_1' =$ Volume in board feet as shown by the Spaulding Log Rule. $O_1' =$ "Mill over-run" $= A_1' - As_1'$.

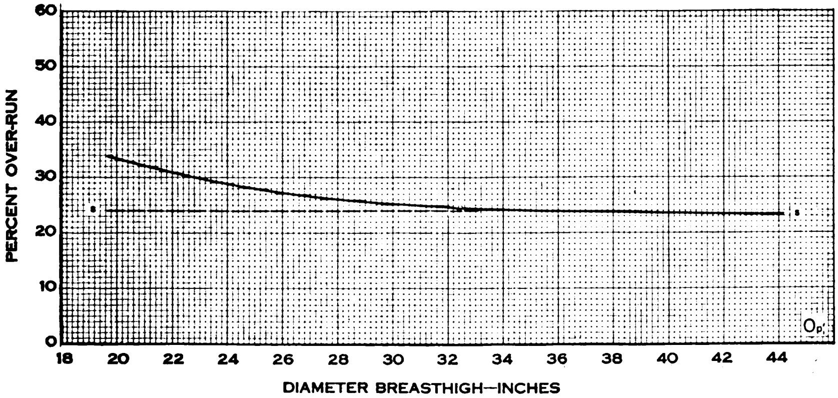

FIG. 206.—Curves showing per cent of "Mill over-run" for butt logs from mature trees.

$$\frac{100\,(A_1' - As_1')}{As_1'} = \frac{100\,O_1'}{As_1'} = Op_1'.$$

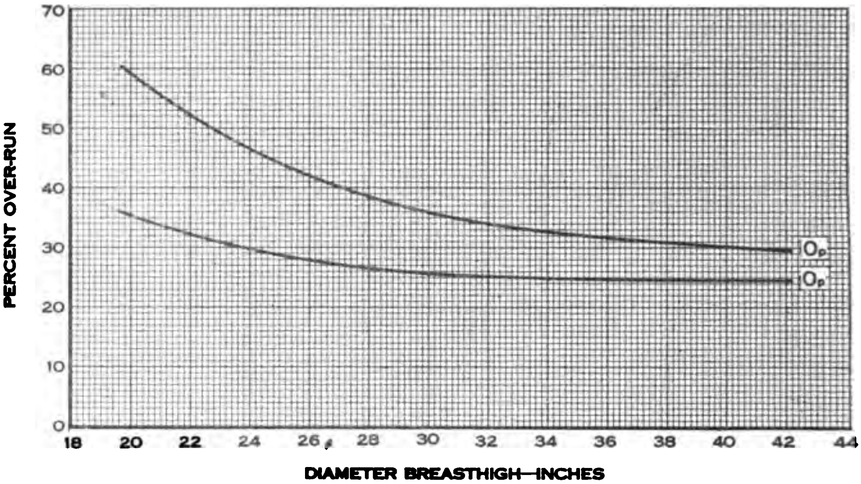

FIG. 207.—A comparison of per cent "over-run" for butt logs and whole trees, of immature western yellow pine.

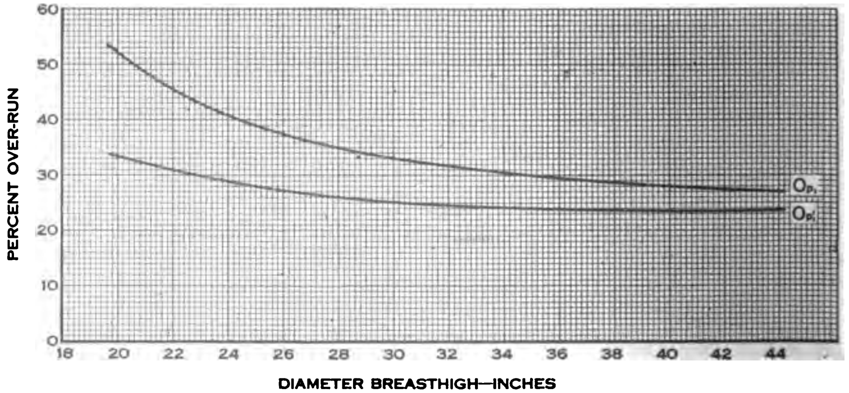

FIG. 208.—A comparison of per cent "over-run" for butt logs and whole trees, of mature western yellow pine.

PART III. TABULATED RESULTS.

AVERAGE VALUES FOR WHOLE TREES.

TABLE 1.—*Age and dimensions.*

(Values read from curves shown in Figs. 4, 5 and 80.)

Diameter breast-high in inches	IMMATURE					MATURE				
	Clear length in feet	Merch. length in feet	Total height in feet	Age in years	D. I. B. top log in inches	Clear length in feet	Merch. length in feet	Total height in feet	Age in years	D. I. B. top log in inches
20	24	84	102	195	6.7	25	84	96	270	7.2
21	24	87	104	200	6.7	26	87	100	280	7.3
22	24	89	107	200	6.8	27	91	104	285	7.5
23	24	91	109	205	6.8	28	94	107	290	7.7
24	24	94	111	205	6.9	29	97	110	295	7.9
25	24	96	113	210	7.0	29	100	113	305	8.1
26	24	99	115	215	7.0	30	103	116	310	8.3
27	25	101	118	215	7.2	30	105	118	315	8.5
28	25	104	120	220	7.2	31	107	121	325	8.7
29	25	106	122	225	7.3	31	110	123	330	8.9
30	25	108	124	225	7.3	32	112	125	335	9.1
31	25	110	126	230	7.4	32	114	128	345	9.3
32	25	112	128	235	7.5	33	117	130	350	9.6
33	25	115	130	240	7.7	33	119	132	360	9.8
34	25	117	132	245	7.7	34	121	134	365	10.0
35	26	119	133	250	7.8	34	123	136	375	10.2
36	26	121	135	255	7.9	34	125	138	380	10.5
37	26	123	137	260	8.2	35	127	139	390	10.7
38	26	125	139	270	8.6	35	129	141	395	11.0
39	26	127	141	275	9.0	35	131	143	405	11.2
40	26	129	142	285	9.6	36	133	145	410	11.5
41	26	131	143	295	10.3	36	135	147	420	11.8
42	26	133	145	305	11.2	36	137	148	430	12.1
43	---------	---------	---------	---------	---------	37	138	150	435	12.3
44	---------	---------	---------	---------	---------	37	141	152	445	12.7

TABLE 2.—*Form factors for merchantable portion of western yellow pine trees of different diameters breasthigh.*

$$\text{Form factor} = \frac{\text{Vol. cu. ft. inside bark contained in merch. lgth.}}{.7854 \div 144\ (\text{D.B.H.})^2 \times \text{merch. lgth. in feet}}$$

Diameter breasthigh in inches	IMMATURE			MATURE		
	Merch. volume in cubic feet	Volume of cylinder in cubic feet	Form factor	Merch. volume in cubic feet	Volume of cylinder in cubic feet	Form factor
20	80	183	.437	83	183	.453
22	98	235	.417	106	240	.442
24	119	295	.404	133	304	.437
26	143	364	.395	165	379	.436
28	173	443	.391	200	457	.438
30	207	529	.391	241	548	.439
32	244	625	.391	288	653	.442
34	287	737	.390	339	761	.445
36	333	854	.390	395	882	.448
38	384	984	.390	457	1013	.450
40	437	1122	.389	523	1159	.451
42	497	1278	.389	595	1315	.453
44	-------------	-------------	-------------	667	1450	.459

A Comparison of Quality of Top Logs, Whole Trees, and Butt Logs.

Diagrams showing the high, intermediate, and low grades, sawed from top logs, whole trees, and butt logs, of immature trees of different diameters breasthigh, expressed in per cent of total sawed out.

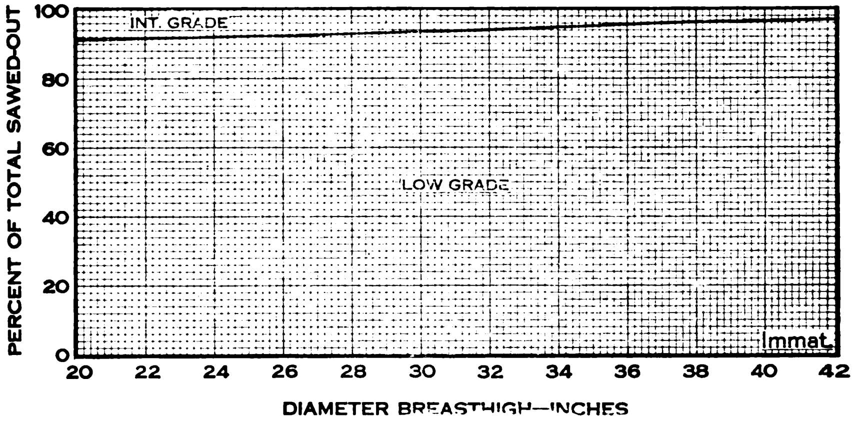

Fig. 193.—Top logs. $Ap'' + Bp'' + Cp'' = 100\%$.

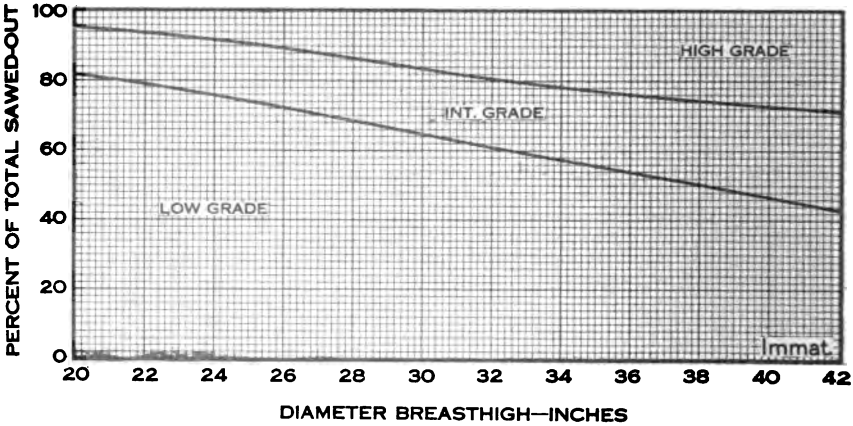

Fig. 194.—Whole trees. $Ap + Bp + Cp = 100\%$.

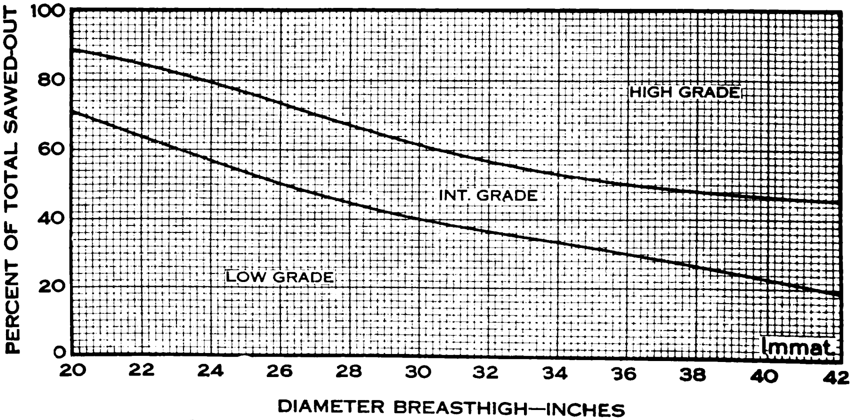

Fig. 195.—Butt logs. $Ap' + Bp' + Cp' = 100\%$.

Diagrams showing the high, intermediate, and low grades, sawed from top logs, whole trees, and butt logs, of mature trees of different diameters breasthigh, expressed in per cent of total sawed out.

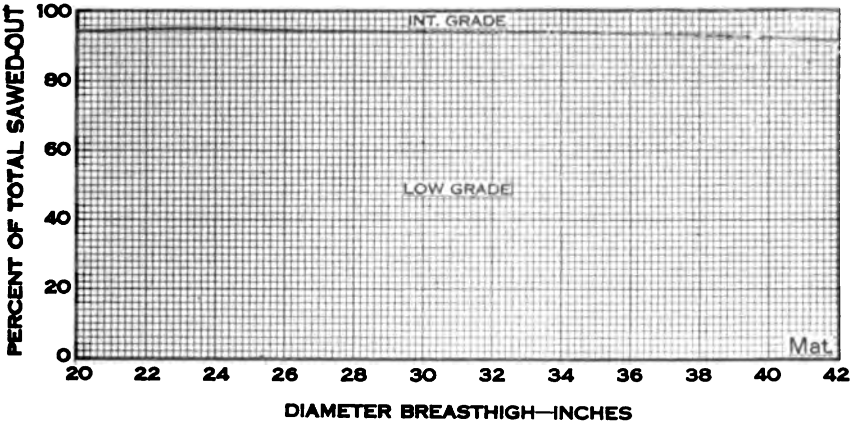

Fig. 196.—Top logs. $Ap_1'' + Bp_1'' + Cp_1'' = 100\%$.

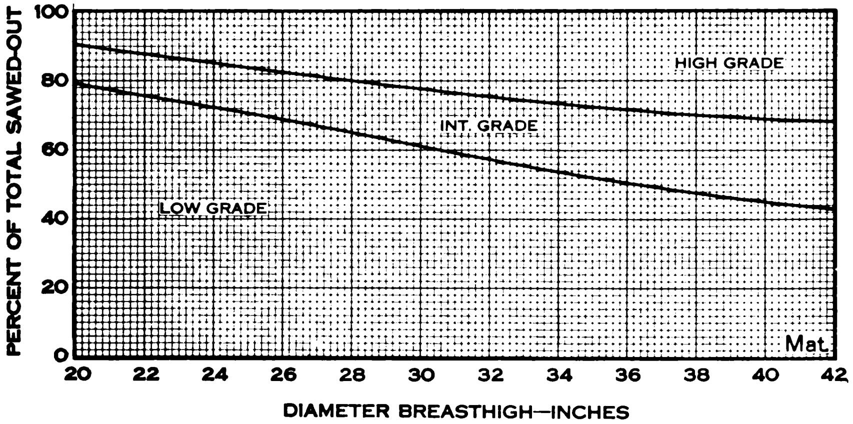

Fig. 197.—Whole trees. $Ap_1 + Bp_1 + Cp_1 = 100\%$.

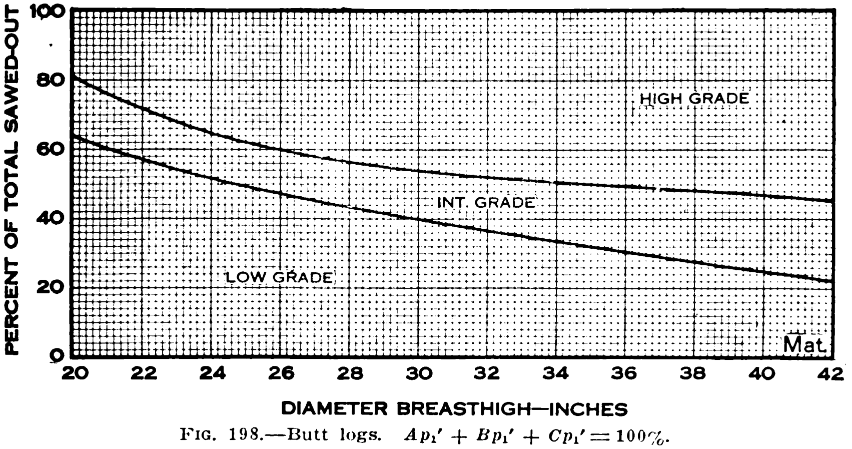

Fig. 198.—Butt logs. $Ap_1' + Bp_1' + Cp_1' = 100\%$.

MILL OVER-RUN.

"Mill over-run" is the difference between the total sawed out volume in board feet and the volume in board feet as indicated by a given log rule, when the former is greater than the latter. Should the total sawed out volume be less than the volume indicated by the log rule, the difference would then be called a "mill under-run."

It is usually customary to express a mill over-run, or under-run, in per cent of volume as indicated by the log rule used. For example: If a log scales 800 board feet and saws out 1000 board feet, the mill over-run is 25%. If it scales 1000 board feet and saws out 800 board feet, the under-run is 20%. If it scales 800 and saws out 800, then it is said to "hold up the scale"; over-run in this case being 0%.

The Spaulding Log Rule, which is the statute rule of California, was used by the Red River Lumber Company in Lassen County, where the field work of this study was conducted, and the following comparisons of total sawed out and log scale are based upon volume indicated by that rule.

In Fig. 199 the average volume in board feet, sawed out at the mill from immature trees of different diameters breasthigh, is shown by Curve A; the average volume for the same trees, as indicated by the Spaulding Log Rule, is shown by Curve As, and the difference between these average curves, which is Curve O, is the average mill over-run from immature trees of different sizes. $(A - As = O)$.

Fig. 200 shows the mill over-run as indicated by Curve O, expressed in per cent of volume in board feet; that is,

$$\frac{100(A - As)}{As} = \frac{100\,O}{As} = Op = \%\ \text{Mill over-run.}$$

Figs. 201 and 202 show similar determinations made for mature yellow pine.

It will be observed that the per cent mill over-run for both immature and mature trees is exceedingly high, and that it is higher for the immature than for the mature, and higher for small trees than for large ones. In Figs. 204 and 206 the same general tendencies will be seen along with the striking feature that these determinations run lower than the ones for whole trees.

These differences are brought about by the log rule used and by local practices in vogue at the mill.

The Spaulding Log Rule, to begin with, has an enormous waste allowance for small logs, which is over 130% of the volume allowed for manufactured product. This allowance becomes smaller as the size of the log in question becomes larger, and approaches 36.5% for very large logs. Such a waste allowance is too large for small logs, even in cases where 36.5% for large logs is about right.

The wastage from small logs should, however, be greater than for large ones, but not three or four times as great, as the Spaulding Log Rule allows. This is why the per cent of mill over-run shown in Figs. 199, 200, 204, and 206 is greater for small diameters than for large ones. It also explains why the per cent over-run for whole trees is much greater than for 16′ but logs from the same trees. The smaller the log the greater the per cent over-run; therefore, a tree 20″ in diameter breasthigh which contains four logs in the merchantable length, three of which are of course smaller than the butt log, has, as a whole, a larger per cent over-run than does the butt log alone. Mature trees and butt logs from them show a lower per cent over-run than do immature trees and butt logs from immature trees of corresponding diameters. The fact that the Spaulding Log Rule is not a level one is also indirectly the cause of this. Mature trees have a thinner bark than the immature, therefore a 16′ butt log from a mature tree of a given diameter breasthigh has a greater diameter inside the bark than a butt log of the same length coming from an immature tree of the same diameter breasthigh. The larger the logs the lower the per cent over-run; hence, the difference between Figs. 204 and 206.

The differences in Figs. 200 and 202 are brought about by thickness of bark together with form of bole. Mature trees show a higher form factor than the immature; they are filled out more, the taper being very slight in the first three or four 16′ logs. The effect of high form factors, or fullness of bole, tends to decrease the per cent of mill over-run.

In Fig. 207 a comparison of per cent over-run for butt logs and whole trees, of immature western yellow pine, is shown, while in Fig. 208 a similar comparison is made for mature trees and 16′ butt logs from them. It will be observed that there is at least 23% over-run in all cases, regardless of size of log or tree. This difference between actual cut at the mill and the Spaulding Log Rule is easily accounted for, since the Spaulding rule was constructed for a thick saw, and since some of the lumber sawed was cut shy on dimensions, and that clear, straight grained edgings were usually graded as moulding stock.

NOTE.—During the season of 1915 it was learned that the company had discontinued the practice of cutting shy on dimensions.

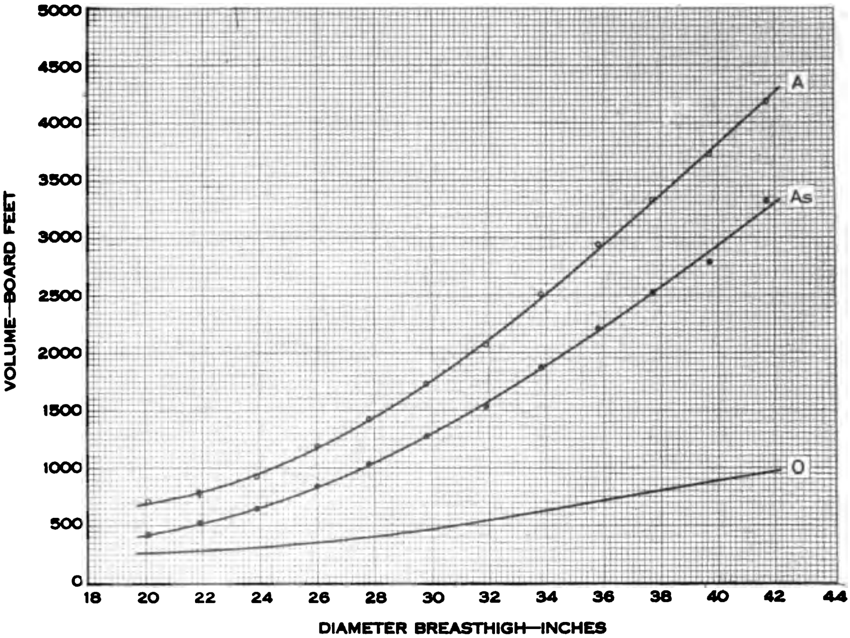

FIG. 199.—Curves showing "mill over-run" for immature trees of different diameters breasthigh. A = Volume in board feet actually sawed out at mill. As = Volume in board feet as shown by the Spaulding Log Rule. O = "Mill over-run" = A — As.

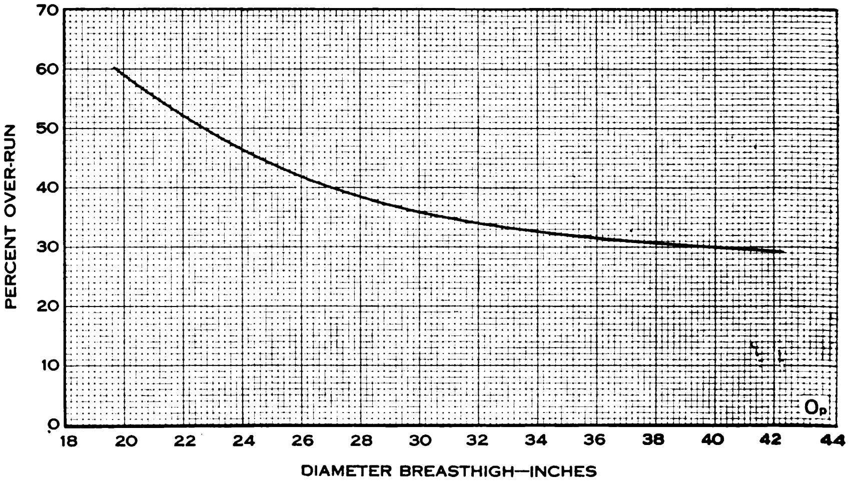

FIG. 200.—Curve showing per cent of "mill over-run" for immature trees.

$$\frac{100\,(A - As)}{As} = \frac{100\,O}{As} = Op.$$

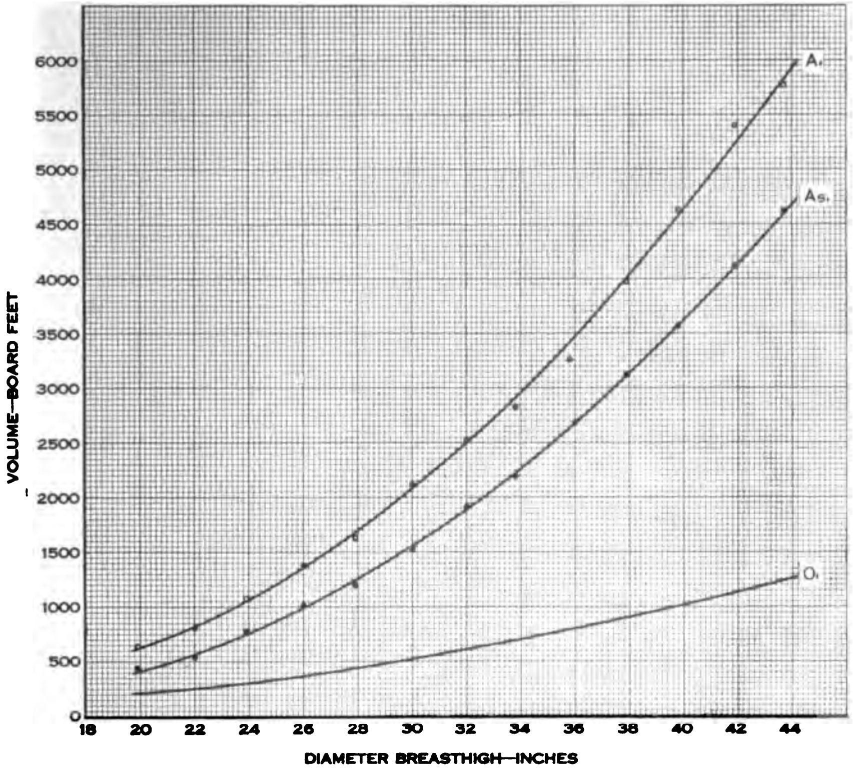

Fig. 201.—Curves showing "mill over-run" for mature trees of different diameters breasthigh. A_1 = Volume in board feet actually sawed out at mill. As_1 = Volume in board feet as shown by the Spaulding Log Rule. O_1 = "Mill over-run" = $A_1 - As_1$.

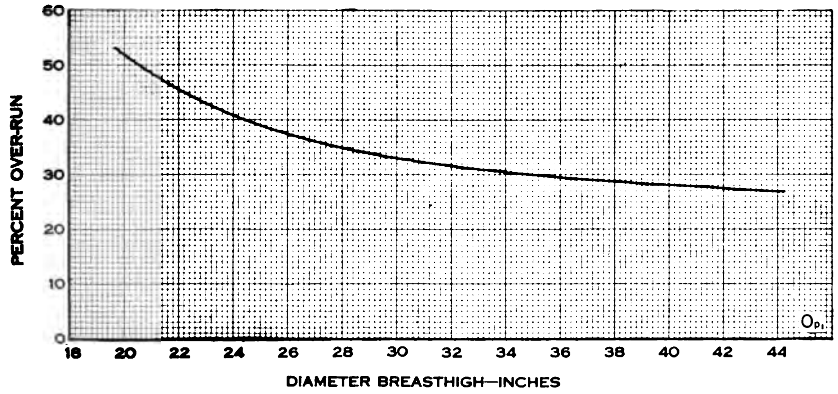

Fig. 202.—Curve showing per cent of "mill over-run" for mature trees.

$$\frac{100\,(A_1 - As_1)}{As_1} = \frac{100\,O_1}{As_1} = Op_1.$$

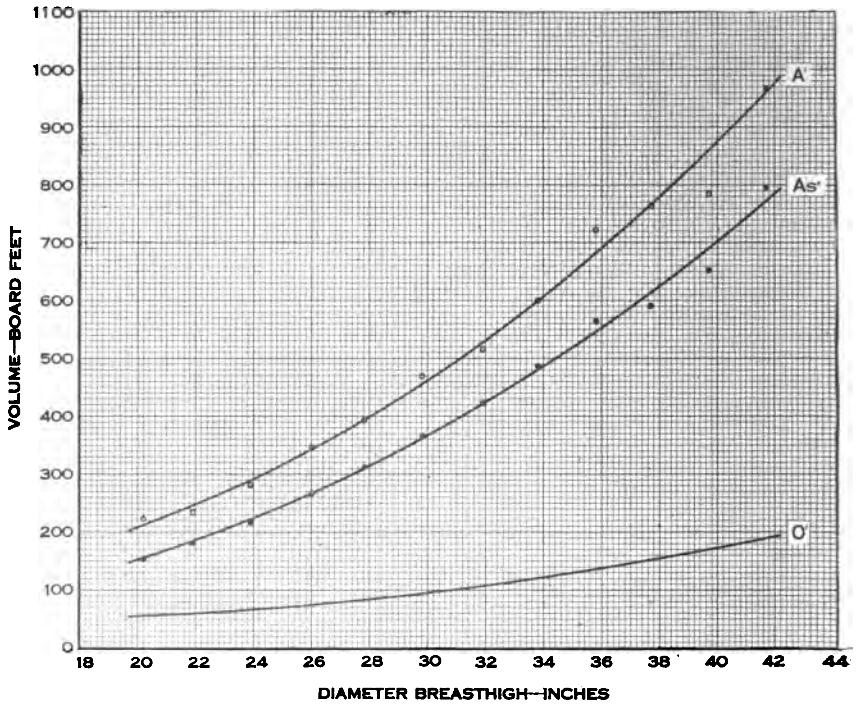

FIG. 203.—Curves showing "mill over-run" for butt logs from immature trees of different diameters breasthigh. A′ = Volume in board feet actually sawed out at mill. As′ = Volume in board feet as shown by the Spaulding Log Rule. O′ = "Mill over-run" = A′ — As′.

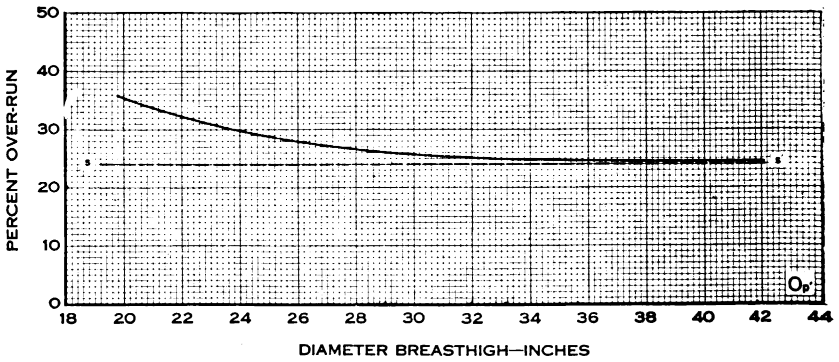

FIG. 204.—Curves showing per cent of "mill over-run" for butt logs from immature trees.

$$\frac{100\,(A' - As')}{As'} = \frac{100\,O'}{As'} = Op'.$$

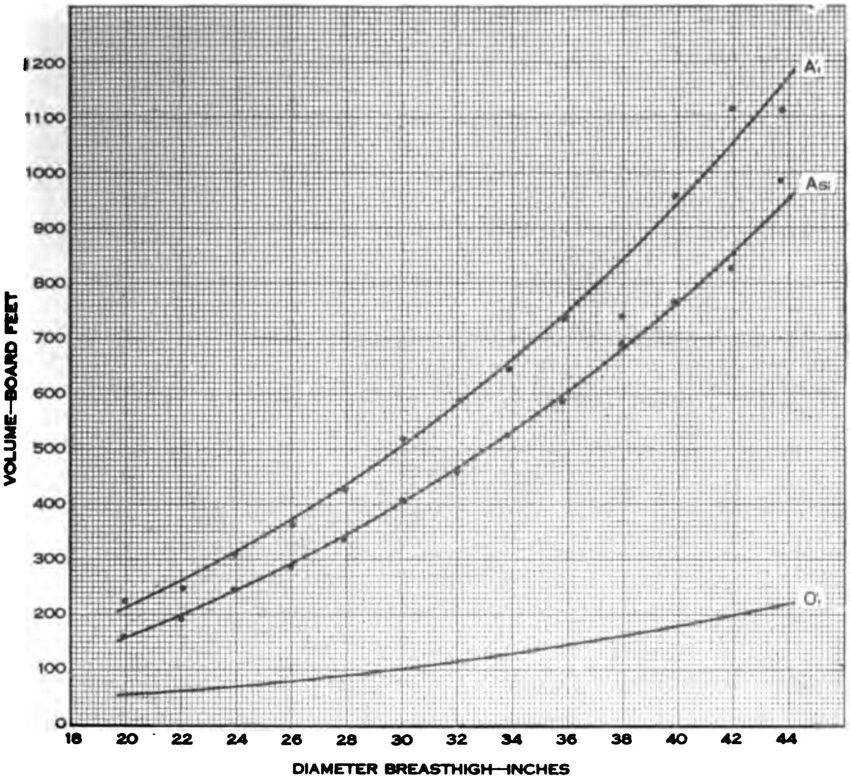

FIG. 205.—Curves showing "mill over-run" for butt logs from mature trees of different diameters breasthigh. A_1' = Volume in board feet actually sawed out at mill. As_1' = Volume in board feet as shown by the Spaulding Log Rule. O_1' = "Mill over-run" = $A_1' - As_1'$.

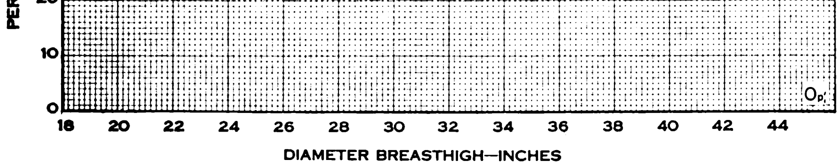

FIG. 206.—Curves showing per cent of "Mill over-run" for butt logs from mature trees.

$$\frac{100\,(A_1' - As_1')}{As_1'} = \frac{100\,O_1'}{As_1'} = Op_1'.$$

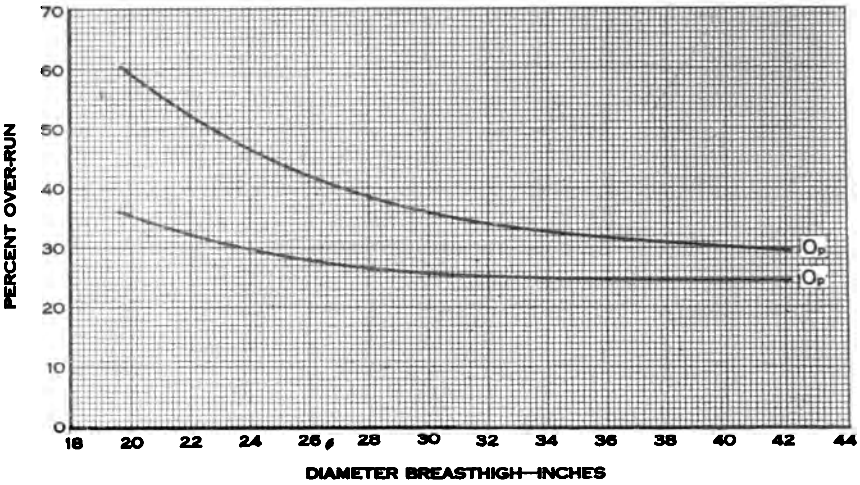

FIG. 207.—A comparison of per cent "over-run" for butt logs and whole trees, of immature western yellow pine.

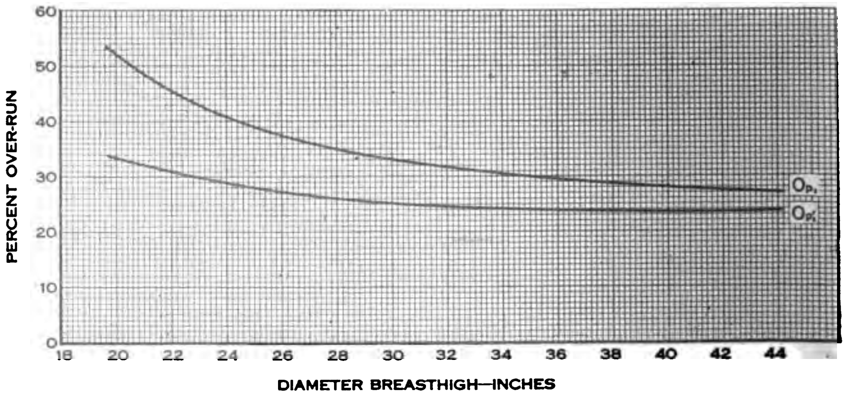

FIG. 208.—A comparison of per cent "over-run" for butt logs and whole trees, of mature western yellow pine.

PART III. TABULATED RESULTS.

AVERAGE VALUES FOR WHOLE TREES.

TABLE 1.—*Age and dimensions.*

(Values read from curves shown in Figs. 4, 5 and 80.)

Diameter breast-high in inches	IMMATURE					MATURE				
	Clear length in feet	Merch. length in feet	Total height in feet	Age in years	D. I. B. top log in inches	Clear length in feet	Merch. length in feet	Total height in feet	Age in years	D. I. B. top log in inches
20	24	84	102	195	6.7	25	84	96	270	7.2
21	24	87	104	200	6.7	26	87	100	280	7.3
22	24	89	107	200	6.8	27	91	104	285	7.5
23	24	91	109	205	6.8	28	94	107	290	7.7
24	24	94	111	205	6.9	29	97	110	295	7.9
25	24	96	113	210	7.0	29	100	113	305	8.1
26	24	99	115	215	7.0	30	103	116	310	8.3
27	25	101	118	215	7.2	30	105	118	315	8.5
28	25	104	120	220	7.2	31	107	121	325	8.7
29	25	106	122	225	7.3	31	110	123	330	8.9
30	25	108	124	225	7.3	32	112	125	335	9.1
31	25	110	126	230	7.4	32	114	128	345	9.3
32	25	112	128	235	7.5	33	117	130	350	9.6
33	25	115	130	240	7.7	33	119	132	360	9.8
34	25	117	132	245	7.7	34	121	134	365	10.0
35	26	119	133	250	7.8	34	123	136	375	10.2
36	26	121	135	255	7.9	34	125	138	380	10.5
37	26	123	137	260	8.2	35	127	139	390	10.7
38	26	125	139	270	8.6	35	129	141	395	11.0
39	26	127	141	275	9.0	35	131	143	405	11.2
40	26	129	142	285	9.6	36	133	145	410	11.5
41	26	131	143	295	10.3	36	135	147	420	11.8
42	26	133	145	305	11.2	36	137	148	430	12.1
43	--------	--------	--------	--------	--------	37	138	150	435	12.3
44	--------	--------	--------	--------	--------	37	141	152	445	12.7

TABLE 2.—*Form factors for merchantable portion of western yellow pine trees of different diameters breasthigh.*

$$\text{Form factor} = \frac{\text{Vol. cu. ft. inside bark contained in merch. lgth.}}{.7854 \div 144\ (\text{D.B.H.})^2 \times \text{merch. lgth. in feet}}$$

Diameter brea thigh in inches	IMMATURE			MATURE		
	Merch. volume in cubic feet	Volume of cylinder in cubic feet	Form factor	Merch. volume in cubic feet	Volume of cylinder in cubic feet	Form factor
20	80	183	.437	83	183	.453
22	98	235	.417	106	240	.442
24	119	295	.404	133	304	.437
26	143	364	.395	165	379	.436
28	173	443	.391	200	457	.438
30	207	529	.391	241	548	.439
32	244	625	.391	288	653	.442
34	287	737	.390	339	761	.445
36	333	854	.390	395	882	.448
38	384	984	.390	457	1013	.450
40	437	1122	.389	523	1159	.451
42	497	1278	.389	595	1315	.453
44	------------	------------	------------	667	1450	.459

TABLE 3.—*Average volume in board feet of each grade actually "sawed out" at mill, from merchantable portion of immature western yellow pine trees of different diameters breasthigh.*

(Values read from curves shown on left-hand pages, Nos. 40 to 54, inclusive.)

Diameter breasthigh in inches	HIGH GRADES					INTERMEDIATE GRADES						LOW GRADES									Total sawed out, all grades
	C. & Bet. 6/4	Mldg. Stock	No. 1 Shop 6/4	D. Sel. & Bet. 1"	Total	No. 1 Com. 1"	No. 2 Com. 1"	Shop 1"	No. 2 Shop 6/4	Shims	Total	Box 1"	Cull 2"	Box 6/4	No. 3 Shop 6/4	No. 3 Com. 1"	Plank 3"	4x4 & Lgr.	2x4 & wider No. 1 Dim.	Total	
	a +	b +	c +	d =	Av.	e +	f +	g +	h +	i =	Bv.	j +	k +	l +	m +	n +	o +	p +	q =	Cv.	A
20	0	15	4	10	29	30	35	8	14	8	95	60	5	90	45	25	8	118	210	561	685
21	5	17	5	12	39	29	37	10	19	10	105	64	5	96	49	26	12	122	216	590	734
22	8	19	6	15	48	28	40	12	25	12	117	68	5	103	58	27	16	126	222	625	790
23	13	22	10	17	62	28	43	15	34	15	135	72	6	110	67	28	21	134	236	674	871
24	18	25	15	20	78	27	45	19	46	16	153	76	7	114	80	30	26	142	250	725	956
25	23	28	24	23	98	27	47	20	61	18	173	80	8	120	92	31	30	158	267	786	1057
26	32	32	35	26	125	26	50	22	78	20	196	84	8	128	106	33	35	175	285	854	1175
27	44	36	51	29	160	26	53	25	99	22	225	87	8	134	120	35	37	194	305	920	1305
28	60	40	70	32	202	25	55	28	122	25	255	90	8	140	135	36	40	214	325	988	1445
29	75	44	88	36	243	25	58	34	147	28	292	93	8	146	154	37	43	236	346	1063	1598
30	95	48	109	41	293	24	60	40	174	32	330	95	7	149	171	39	43	259	367	1133	1756
31	118	52	132	46	348	23	63	46	202	37	371	98	7	158	190	41	50	281	390	1215	1934
32	145	57	158	52	412	22	65	54	233	42	416	101	7	161	210	42	54	303	413	1291	2119
33	170	63	185	56	474	22	68	66	267	48	471	103	7	168	228	43	56	317	447	1309	2314
34	200	70	215	61	546	21	70	80	304	54	529	106	7	172	248	45	59	332	482	1451	2526
35	231	76	247	66	620	21	72	93	344	61	594	108	12	178	264	48	61	346	512	1529	2743
36	266	83	282	72	703	21	75	114	384	68	662	110	18	181	280	50	63	351	542	1595	2960
37	300	88	317	77	782	21	79	136	426	76	738	112	25	187	292	55	64	375	545	1655	3175
38	338	94	353	82	838	21	84	160	468	85	818	115	33	189	303	60	66	400	535	1701	3387
39	372	101	390	88	951	21	91	186	511	95	904	117	42	192	312	66	68	435	510	1742	3597
40	413	108	428	94	1043	21	98	215	555	106	995	120	51	193	323	72	70	470	485	1787	3825
41	452	115	466	99	1132	21	111	248	600	121	1101	122	63	198	330	81	71	508	435	1808	4041
42	495	122	505	104	1226	21	115	282	645	135	1198	124	75	202	340	90	73	547	385	1836	4260

TABLE 4.—*Average volume in board feet of each grade actually "sawed out" at mill, from merchantable portion of mature western yellow pine trees of different diameters breasthigh.*

(Values read from curves shown on right-hand pages, Nos. 41 to 55, inclusive.)

Diameter breasthigh in inches	HIGH GRADES					INTERMEDIATE GRADES						LOW GRADES									Total sawed out, all grades
	C. & Bet. 6/4	Mldg. Stock	No. 1 Shop 6/4	D. Sel. & Bet. 1"	Total	No. 1 Com. 1"	No. 2 Com. 1"	Shop 1"	No. 2 Shop 6/4	Shims	Total	Box 1"	Cull , 2"	Box 6/4	No.3 Shop 6/4	No. 3 Com. 1"	Plank 3"	4x4 & Lgr.	2x4 & wider No. 1 Dim.	Total	
	a_1 +	b_1 +	c_1 +	d_1	= Av_1	e_1 +	f_1 +	g_1 +	h_1 +	i_1	= Bv_1	j_1 +	k_1 +	l_1 +	m_1 +	n_1 +	o_1 +	p_1 +	q_1	= Cv_1	A_1
20	0	24	12	22	58	12	30	12	7	8	69	52	9	92	42	32	8	70	195	500	627
21	0	28	13	26	67	12	31	14	12	9	78	55	9	100	50	34	12	90	208	558	703
22	27	32	17	32	108	12	32	16	22	10	92	60	9	105	58	35	20	112	220	619	819
23	36	36	22	36	130	12	34	18	34	12	110	65	10	115	68	35	25	140	234	692	932
24	52	40	30	40	162	12	35	21	48	14	130	70	10	122	80	36	31	172	250	771	1063
25	67	44	40	43	194	12	36	24	68	16	156	75	11	130	94	37	36	205	268	856	1206
26	86	49	52	48	235	12	37	30	88	18	185	80	11	138	108	38	42	236	285	938	1358
27	108	53	70	54	285	12	38	35	115	20	220	85	12	145	125	40	48	265	308	1028	1533
28	130	58	92	58	338	12	40	42	142	22	258	90	12	154	140	41	52	292	328	1109	1705
29	152	62	120	62	396	12	41	52	172	24	301	95	12	160	155	41	59	318	350	1190	1887
30	176	68	150	68	462	11	42	62	208	26	349	100	13	168	174	42	64	340	375	1276	2087
31	206	74	185	72	537	11	43	74	245	28	401	105	13	174	192	42	69	364	400	1359	2297
32	234	80	222	76	612	11	44	86	280	30	451	110	14	180	212	44	74	382	426	1442	2505
33	265	86	263	81	695	11	46	106	320	33	516	115	14	188	232	45	78	400	454	1526	2737
34	295	93	305	88	781	11	48	128	360	36	583	120	15	194	252	48	82	418	480	1609	2973
35	330	100	350	92	872	11	52	150	408	40	661	125	15	200	272	52	84	430	510	1688	3221
36	365	108	404	100	977	11	54	180	455	44	744	128	16	205	292	56	87	440	540	1764	3485
37	400	115	460	106	1081	11	56	210	505	48	830	134	19	212	312	60	91	448	570	1846	3757
38	440	124	515	112	1191	10	60	240	555	52	917	138	21	218	335	63	93	452	604	1924	4032
39	475	132	572	120	1299	10	62	274	610	56	1012	142	24	222	360	70	96	454	639	2007	4318
40	515	142	640	128	1425	10	65	315	668	62	1120	147	28	228	382	78	100	450	672	2085	4630
41	555	153	702	135	1545	10	70	350	725	71	1226	152	34	234	405	88	103	445	706	2167	4938
42	600	165	770	144	1679	10	75	396	780	79	1340	157	42	240	430	100	106	436	745	2256	5275
43	640	180	840	152	1812	10	80	440	844	88	1462	162	53	244	452	112	109	415	782	2329	5603
44	680	195	912	161	1948	10	86	485	905	100	1586	167	62	250	474	130	112	386	820	2401	5935

TABLE 5.—*Grades sawed from immature trees of different diameters breasthigh, expressed in per cent of total sawed out.*

(Values in this table obtained as indicated by $\frac{100a}{A}+\frac{100b}{A}+$ etc. Curves Ap, Bp and Cp shown in Figs. 54, 55 and 56.)

Diameter breasthigh in inches	HIGH GRADES					INTERMEDIATE GRADES							LOW GRADES								Total sawed out, all grades
	C. & Bet. 6/4	Mldg. Stock	No. 1 Shop 6/4	D. Sel. & Bet. 1"	Total	No. 1 Com. 1"	No. 2 Com. 1"	Shop 1"	No. 2 Shop 6/4	Shims	Total	Box 1"	Cull 2"	Box 6/4	No. 3 Shop 6/4	No. 3 Com. 1"	Plank 3"	4x4 & Lgr.	2x4 & wider No. 1 Dim.	Total	
	$\frac{100a}{A}$ +	$\frac{100b}{A}$ +	$\frac{100c}{A}$ +	$\frac{100d}{A}$ =	Ap	$\frac{100e}{A}$ +	$\frac{100f}{A}$ +	$\frac{100g}{A}$ +	$\frac{100h}{A}$ +	$\frac{100i}{A}$ =	Bp	$\frac{100j}{A}$ +	$\frac{100k}{A}$ +	$\frac{100l}{A}$ +	$\frac{100m}{A}$ +	$\frac{100n}{A}$ +	$\frac{100o}{A}$ +	$\frac{100p}{A}$ +	$\frac{100q}{A}$ =	Cp	A
20	0.0	2.1	0.6	1.5	4.2	4.4	5.1	1.1	2.1	1.1	13.8	8.8	0.7	13.2	6.6	3.7	1.1	17.2	30.7	82.0	685
21	0.7	2.3	0.7	1.6	5.3	4.0	5.0	1.4	2.6	1.4	14.4	8.7	0.7	13.1	6.7	3.5	1.6	16.6	29.4	80.3	734
22	0.9	2.5	0.8	1.9	6.1	3.5	5.1	1.5	3.2	1.5	14.8	8.6	0.7	13.0	7.3	3.4	2.0	16.0	28.1	79.1	790
23	1.5	2.6	1.1	2.0	7.2	3.2	4.9	1.7	3.9	1.7	15.4	8.3	0.7	12.6	7.7	3.2	2.4	15.4	27.1	77.4	871
24	1.9	2.6	1.6	2.1	8.2	2.8	4.7	2.0	4.8	1.7	16.0	7.9	0.7	11.9	8.4	3.1	2.7	14.9	26.2	75.8	956
25	2.2	2.6	2.3	2.2	9.3	2.6	4.5	1.9	5.8	1.7	16.5	7.6	0.8	11.3	8.6	2.9	2.8	14.9	25.3	74.2	1057
26	2.7	2.7	2.9	2.2	10.5	2.2	4.3	1.9	6.6	1.7	16.7	7.2	0.7	10.9	9.0	2.8	3.0	14.9	24.3	72.8	1175
27	3.4	2.8	3.9	2.2	12.3	2.0	4.1	1.9	7.6	1.7	17.3	6.7	0.6	10.3	9.2	2.7	2.8	14.8	23.3	70.4	1305
28	4.2	2.7	4.8	2.2	13.9	2.2	3.8	1.8	8.4	1.7	17.9	6.2	0.5	9.7	9.5	2.4	2.8	14.8	22.5	68.2	1445
29	4.7	2.8	5.5	2.3	15.3	1.6	3.6	2.1	9.2	1.8	18.3	5.8	0.5	9.1	9.6	2.3	2.7	14.8	21.6	66.4	1598
30	5.4	2.7	6.2	2.3	16.6	1.4	3.4	2.3	9.9	1.8	18.8	5.4	0.4	8.5	9.8	2.2	2.6	14.8	20.9	64.6	1756
31	6.1	2.7	6.8	2.4	18.0	1.2	3.3	2.4	10.4	1.9	19.2	5.1	0.4	8.2	9.8	2.1	2.5	14.6	20.1	62.8	1934
32	6.8	2.7	7.5	2.4	19.4	1.0	3.1	2.6	11.0	1.9	19.6	4.8	0.3	7.6	10.0	2.0	2.5	14.3	19.5	61.0	2119
33	7.4	2.8	8.0	2.4	20.6	0.9	2.9	2.8	11.5	2.1	20.2	4.5	0.3	7.3	9.9	1.9	2.4	13.6	19.3	59.2	2314
34	7.9	2.8	8.5	2.4	21.6	0.8	2.8	3.2	12.1	2.1	21.0	4.2	0.3	6.8	9.8	1.8	2.3	13.1	19.1	57.4	2526
35	8.4	2.8	9.0	2.4	22.6	0.8	2.6	3.5	12.6	2.2	21.7	4.3	0.4	6.5	9.6	1.8	2.2	12.6	18.3	55.7	2743
36	8.9	2.8	9.5	2.4	23.6	0.7	2.6	3.9	13.0	2.3	22.5	3.7	0.6	6.1	9.5	1.7	2.1	11.9	18.3	53.9	2960
37	9.4	2.8	10.0	2.5	24.7	0.7	2.5	4.3	13.4	2.4	23.3	3.5	0.8	5.9	9.2	1.7	2.0	11.8	17.1	52.0	3175
38	10.0	2.8	10.4	2.4	25.6	0.6	2.5	4.7	13.8	2.5	24.1	3.4	0.9	5.6	9.0	1.8	2.0	11.8	15.8	50.3	3387
39	10.3	2.8	10.9	2.4	26.4	0.6	2.5	5.2	14.2	2.6	25.1	3.3	1.2	5.3	8.7	1.8	1.9	12.1	14.2	48.5	3597
40	10.8	2.8	11.2	2.5	27.3	0.5	2.6	5.6	14.5	2.8	26.0	3.1	1.3	5.1	8.5	1.9	1.8	12.3	12.7	46.7	3825
41	11.2	2.8	11.5	2.4	27.9	0.5	2.7	6.1	14.9	3.0	27.2	3.0	1.6	4.9	8.2	2.0	1.8	12.6	10.8	44.9	4041
42	11.6	2.8	11.9	2.4	28.7	0.5	2.7	6.6	15.2	3.2	28.2	2.9	1.8	4.8	8.0	2.1	1.7	12.8	9.0	43.1	4260

TABLE 6.—*Grades sawed from mature trees of different diameters breasthigh, expressed in per cent of total sawed out.*

(Values in this table obtained as indicated by $\frac{100a_1}{A_1}+\frac{100b_1}{A_1}+$ etc. Curves Ap_1, Bp_1 and Cp_1 shown in Figs. 57, 58 and 59.)

Diameter breasthigh in inches	HIGH GRADES					INTERMEDIATE GRADES						LOW GRADES									Total sawed out, all grades
	C. & Bet. 6/4	Mldg. Stock	No. 1 Shop 6/4	D. Sel. & Bet. 1"	Total	No. 1 Com. 1"	No. 2 Com. 1"	Shop 1"	No. 2 Shop 6/4	Shims	Total	Box 1"	Cull 2"	Box 6/4	No. 3 Shop 6/4	No. 3 Com. 1"	Plank 3"	4x4 & Lgr.	2x4 & wider No. 1 Dim.	Total	
	$\frac{100a_1}{A_1}+$	$\frac{100b_1}{A_1}+$	$\frac{100c_1}{A_1}+$	$\frac{100d_1}{A_1}$	$=Ap_1$	$\frac{100e_1}{A_1}+$	$\frac{100f_1}{A_1}+$	$\frac{100g_1}{A_1}+$	$\frac{100h_1}{A_1}+$	$\frac{100i_1}{A_1}$	$=Bp_1$	$\frac{100j_1}{A_1}+$	$\frac{100k_1}{A_1}+$	$\frac{100l_1}{A_1}+$	$\frac{100m_1}{A_1}+$	$\frac{100n_1}{A_1}+$	$\frac{100o_1}{A_1}+$	$\frac{100p_1}{A_1}+$	$\frac{100q_1}{A_1}$	$=Cp_1$	A_1
20	0.0	3.8	1.9	3.5	9.2	1.9	4.8	1.9	1.1	1.3	11.0	8.3	1.4	14.7	6.7	5.1	1.3	11.2	31.1	79.8	627
21	0.0	4.0	1.9	3.7	9.6	1.7	4.4	2.0	1.7	1.3	11.1	7.8	1.3	14.2	7.1	4.8	1.7	12.8	29.6	79.3	703
22	3.3	3.9	2.1	3.9	13.2	1.5	3.9	2.0	2.7	1.2	11.3	7.3	1.1	12.8	7.1	4.3	2.4	13.7	26.8	75.5	819
23	3.9	3.9	2.4	3.9	14.1	1.3	3.6	1.9	3.6	1.3	11.7	7.0	1.0	12.3	7.3	3.8	2.7	15.0	25.1	74.2	932
24	4.9	3.8	2.8	3.8	15.3	1.1	3.3	2.0	4.5	1.3	12.2	6.6	0.9	11.5	7.5	3.4	2.9	16.2	23.5	72.5	1063
25	5.6	3.6	3.3	3.6	16.1	1.0	3.0	2.0	5.6	1.3	12.9	6.2	0.9	10.8	7.8	3.1	3.0	17.0	22.2	71.0	1206
26	6.3	3.6	3.8	3.5	17.2	0.9	2.7	2.2	6.5	1.3	13.6	5.9	0.8	10.2	8.0	2.8	3.1	17.4	21.0	69.2	1358
27	7.0	3.5	4.6	3.5	18.6	0.8	2.5	2.3	7.5	1.3	14.4	5.5	0.8	9.5	8.1	2.6	3.1	17.3	20.1	67.0	1533
28	7.6	3.4	5.4	3.4	19.8	0.7	2.4	2.5	8.3	1.3	15.2	5.3	0.7	9.0	8.2	2.4	3.1	17.1	19.2	65.0	1705
29	8.1	3.3	6.4	3.3	21.1	0.6	2.2	2.8	9.1	1.3	16.0	5.0	0.6	8.5	8.2	2.2	3.1	16.8	18.5	62.9	1887
30	8.4	3.3	7.2	3.3	22.2	0.5	2.0	3.0	10.0	1.2	16.7	4.8	0.6	8.0	8.3	2.0	3.1	16.8	18.0	61.1	2087
31	9.0	3.2	8.1	3.1	23.4	0.6	1.9	3.2	10.7	1.2	17.5	4.6	0.6	7.5	8.4	1.8	3.0	15.8	17.4	59.1	2297
32	9.3	3.2	8.9	3.0	24.4	0.4	1.8	3.4	11.2	1.2	18.0	4.4	0.5	7.2	8.5	1.8	3.0	15.2	17.0	57.6	2505
33	9.7	3.1	9.6	3.0	25.4	0.4	1.7	3.9	11.7	1.2	18.9	4.2	0.5	6.9	8.5	1.6	2.8	14.6	16.6	55.7	2737
34	9.9	3.1	10.2	3.0	26.2	0.4	1.6	4.3	12.1	1.2	19.6	4.0	0.5	6.6	8.5	1.6	2.8	14.1	16.1	54.2	2973
35	10.2	3.1	10.9	2.9	27.1	0.3	1.6	4.7	12.7	1.2	20.5	3.9	0.5	6.2	8.5	1.6	2.6	13.3	15.8	52.4	3221
36	10.5	3.1	11.6	2.9	28.1	0.3	1.5	5.1	13.1	1.3	21.3	3.6	0.5	5.9	8.4	1.6	2.5	12.6	15.5	50.6	3485
37	10.7	3.1	12.2	2.8	28.8	0.3	1.5	5.6	13.5	1.3	22.2	3.5	0.5	5.6	8.3	1.6	2.4	11.9	15.2	49.0	3757
38	10.9	3.1	12.8	2.8	29.6	0.2	1.5	5.9	13.7	1.3	22.6	3.4	0.5	5.4	8.3	1.6	2.3	11.2	15.1	47.8	4032
39	11.0	3.1	13.3	2.8	30.2	0.2	1.4	6.3	14.2	1.3	23.4	3.3	0.6	5.1	8.3	1.6	2.2	10.5	14.8	46.4	4318
40	11.1	3.1	13.8	2.8	30.8	0.2	1.4	6.8	14.4	1.3	24.1	3.2	0.6	4.9	8.3	1.7	2.2	9.7	14.5	45.1	4630
41	11.2	3.1	14.2	2.8	31.3	0.2	1.4	7.1	14.7	1.4	24.8	3.1	0.7	4.7	8.2	1.8	2.1	9.0	14.3	43.9	4938
42	11.3	3.1	14.6	2.7	31.7	0.2	1.4	7.5	14.8	1.5	25.4	3.0	0.8	4.6	8.2	1.9	2.0	8.3	14.1	42.9	5275
43	11.4	3.2	15.0	2.7	32.3	0.2	1.4	7.9	15.1	1.6	26.2	2.9	0.9	4.4	8.0	2.0	1.9	7.4	14.0	41.5	5608
44	11.5	3.3	15.4	2.7	32.9	0.2	1.4	8.2	15.3	1.7	26.8	2.8	1.0	4.2	8.0	2.2	1.9	6.5	13.7	40.3	5985

TABLE 7.—*Value of grades sawed from immature trees of different diameters breasthigh, expressed in dollars and cents.*

(Values in this table obtained as indicated by .032*a* + .030*b* + etc. Curves Aval, Bval and Cval shown in Figs. 62, 63 and 64.)

Diameter breasthigh in inches	HIGH GRADES					INTERMEDIATE GRADES						LOW GRADES									
	C. & Bet. 6/4	Mldg. Stock	*No. 1 Shop 6/4	D. Sel. & Bet. 1"	Total	No. 1 Com. 1"	No. 2 Com. 1"	Shop 1"	No. 2 Shop 6/4	Shims	Total	Box 1"	Cull 2"	Box 6/4	No. 3 Shop 6/4	No. 3 Com. 1"	Plank 2"	1x4 & 1x6	2x4 & wider No. 1 Dim.	Total	Value per tree
	.032a +	.030b +	.027c +	.025d	Aval.	.022e +	.018f +	.018g +	.018h +	.007i =	Bval.	.009j +	.007k +	.011l +	.018m +	.015n +	.016o +	.016p +	.015q	Cval.	D
20	.00	.45	.11	.25	.81	.60	.68	.14	.25	.06	1.74	.54	.04	.99	.58	.37	.19	1.77	3.16	7.56	10.11
21	.16	.51	.14	.30	1.11	.64	.67	.18	.34	.07	1.90	.58	.04	1.00	.64	.39	.18	1.84	3.24	7.96	10.97
22	.26	.57	.16	.38	1.37	.62	.72	.21	.45	.08	2.08	.61	.14	1.16	.76	.40	.24	1.90	3.33	8.39	11.84
23	.42	.66	.27	.43	1.78	.60	.77	.27	.61	.10	2.35	.65	.04	1.21	.87	.42	.31	2.01	3.54	9.05	13.18
24	.58	.75	.41	.50	2.24	.59	.81	.34	.83	.11	2.68	.68	.15	1.25	1.04	.40	.39	2.13	3.70	9.74	14.66
25	.74	.84	.65	.57	2.80	.59	.85	.30	1.10	.13	2.97	.77	.05	1.32	1.90	.47	.45	2.37	4.09	10.60	16.43
26	1.02	.96	.95	.65	3.58	.57	.90	.40	1.40	.14	3.41	.75	.05	1.41	1.58	.49	.50	2.08	4.28	11.52	18.51
27	1.41	1.08	1.38	.73	4.00	.57	.95	.45	1.78	.15	3.90	.78	.15	1.48	1.60	.50	.55	2.91	4.56	12.44	20.34
28	1.92	1.20	1.89	.80	5.81	.55	.99	.50	2.19	.17	4.40	.81	.05	1.54	1.70	.54	.60	3.31	4.88	13.80	24.01
29	2.40	1.32	2.38	.90	7.00	.55	1.05	.61	2.05	.20	4.46	.84	.05	1.61	2.00	.56	.65	3.54	5.90	14.45	26.51
30	3.04	1.44	2.94	1.02	8.44	.53	1.08	.72	3.13	.22	5.68	.90	.15	1.64	2.22	.59	.69	3.80	5.50	15.44	28.96
31	3.78	1.56	3.50	1.15	10.65	.51	1.14	.83	3.64	.26	6.38	.88	.05	1.74	2.47	.62	.75	4.23	5.80	16.08	33.01
32	4.64	1.71	4.27	1.30	11.92	.48	1.17	.97	4.19	.28	7.09	.91	.05	1.77	2.78	.68	.81	4.55	6.20	17.05	36.06
33	5.44	1.89	5.00	1.40	13.73	.48	1.22	1.19	4.81	.34	8.04	.93	.05	1.85	2.97	.64	.84	4.75	6.70	18.73	40.50
34	6.40	2.10	5.81	1.53	15.84	.46	1.26	1.44	5.47	.38	9.01	.95	.05	1.89	3.22	.67	.89	4.98	7.98	19.88	44.73
35	7.40	2.28	6.67	1.65	18.20	.46	1.30	1.73	6.20	.43	10.12	.97	.08	1.96	3.35	.72	.92	5.20	7.08	20.88	49.20
36	8.51	2.49	7.61	1.80	20.41	.46	1.35	2.05	6.91	.48	11.25	.99	.18	1.99	3.64	.75	.95	5.29	8.18	21.84	53.50
37	9.60	2.64	8.57	1.93	22.74	.46	1.42	2.45	7.07	.58	12.58	1.01	.17	2.00	3.80	.82	.98	5.68	8.18	22.08	57.40
38	10.82	2.82	9.58	2.05	25.22	.46	1.51	2.88	8.42	.59	13.86	1.04	.23	2.08	3.94	.90	.99	6.00	8.03	23.21	62.23
39	11.92	3.08	10.55	2.20	27.70	.46	1.64	3.35	9.20	.66	15.81	1.05	.29	2.11	4.07	.99	1.02	6.58	7.65	23.71	66.72
40	13.22	3.24	11.56	2.35	30.37	.46	1.76	3.87	9.99	.74	16.82	1.08	.36	2.16	4.19	1.08	1.05	7.05	7.28	24.25	71.44
41	14.50	3.45	12.60	2.48	33.03	.46	2.00	4.47	10.80	.85	18.58	1.10	.44	2.18	4.29	1.22	1.07	7.62	6.58	24.45	76.06
42	15.84	3.66	13.64	2.60	35.74	.46	2.07	5.08	11.61	.94	20.16	1.12	.53	2.22	4.42	1.35	1.09	8.20	5.77	24.70	80.60

TABLE 8.—*Value of grades sawed from mature trees of different diameters breasthigh, expressed in dollars and cents.*

(Values in this table obtained as indicated by $.032a_1 + .030b_1 +$ etc. Curves Aval,, Bval, and Cval, shown in Figs. 65, 66 and 67.)

Diameter breasthigh in inches	HIGH GRADES					INTERMEDIATE GRADES						LOW GRADES									Value per tree
	C. & Bet. 6/4	Mldg. Stock	No. 1 Shop 6/4	D. Sel. & Bet. 1"	Total	No. 1 Com. 1"	No. 2 Com. 1"	Shop 1"	No. 2 Shop 6/4	Shims	Total	Box 1"	Cull 2"	Box 6/4	No. 3 Shop 6/4	No. 3 Com. 1"	Plank 3"	4x4 & Lgr.	2x4 & wider No. 1 Dim.	Total	
	$.032a_1+$	$.030b_1+$	$.027c_1+$	$.025d_1$	$=\text{Aval}_1$	$.022e_1+$	$.018f_1+$	$.018g_1+$	$.018h_1+$	$.007i_1$	$=\text{Bval}_1$	$.009j_1+$	$.007k_1+$	$.011l_1+$	$.013m_1+$	$.015n_1+$	$.015o_1+$	$.015p_1+$	$.015q_1$	$=\text{Cval}_1$	B_1
20	.00	.72	.32	.55	1.59	.26	.54	.22	.13	.06	1.21	.47	.06	1.01	.55	.48	.12	1.05	2.93	6.67	9.47
21	.00	.84	.35	.65	1.84	.26	.56	.25	.22	.06	1.35	.49	.06	1.10	.65	.51	.21	1.35	3.12	7.49	10.68
22	.86	.96	.46	.80	3.08	.26	.58	.29	.40	.07	1.60	.54	.06	1.16	.75	.53	.30	1.68	3.30	8.32	13.00
23	1.15	1.08	.59	.90	3.72	.26	.61	.32	.61	.08	1.88	.58	.07	1.26	.88	.53	.37	2.10	3.51	9.31	14.91
24	1.66	1.20	.81	1.00	4.67	.26	.63	.38	.86	.10	2.23	.63	.07	1.34	1.04	.54	.46	2.58	3.75	10.39	17.29
25	2.14	1.32	1.08	1.08	5.62	.26	.65	.43	1.22	.11	2.67	.68	.08	1.43	1.22	.55	.54	3.08	4.03	11.61	19.90
26	2.75	1.47	1.41	1.20	6.82	.26	.67	.54	1.58	.13	3.18	.72	.08	1.52	1.40	.57	.63	3.54	4.28	12.74	22.75
27	3.46	1.59	1.89	1.35	8.29	.26	.68	.63	2.07	.14	3.78	.76	.08	1.60	1.63	.60	.72	3.97	4.62	13.98	26.05
28	4.16	1.74	2.48	1.45	9.83	.26	.72	.76	2.56	.15	4.45	.81	.08	1.70	1.82	.62	.78	4.38	4.92	15.11	29.39
29	4.87	1.86	3.24	1.55	11.52	.26	.74	.94	3.09	.17	5.20	.85	.08	1.76	2.02	.62	.89	4.77	5.25	16.22	32.94
30	5.63	2.04	4.05	1.70	13.42	.24	.76	1.12	3.74	.18	6.04	.90	.09	1.85	2.26	.63	.96	5.10	5.62	17.41	36.87
31	6.59	2.22	4.99	1.80	15.60	.24	.77	1.34	4.42	.20	6.97	.95	.09	1.91	2.50	.63	1.04	5.47	6.00	18.59	41.16
32	7.48	2.40	6.00	1.90	17.78	.24	.79	1.55	5.04	.21	7.83	.99	.10	1.98	2.76	.66	1.11	5.73	6.39	19.72	45.33
33	8.48	2.58	7.10	2.02	20.18	.24	.83	1.91	5.76	.23	8.97	1.04	.10	2.07	3.02	.68	1.17	6.00	6.82	20.90	50.05
34	9.44	2.79	8.23	2.20	22.66	.24	.85	2.30	6.48	.25	10.13	1.08	.11	2.13	3.28	.72	1.23	6.28	7.20	22.03	54.82
35	10.58	3.00	9.46	2.30	25.34	.24	.94	2.70	7.35	.28	11.51	1.12	.11	2.20	3.54	.78	1.26	6.45	7.65	23.11	59.96
36	11.68	3.24	10.92	2.50	28.34	.24	.97	3.24	8.19	.31	12.95	1.15	.11	2.26	3.80	.84	1.31	6.60	8.10	24.17	65.46
37	12.80	3.45	12.42	2.65	31.32	.24	1.01	3.78	9.09	.34	14.46	1.21	.13	2.33	4.06	.90	1.37	6.73	8.55	25.28	71.06
38	14.09	3.72	13.91	2.80	34.52	.22	1.08	4.33	9.99	.36	15.98	1.24	.15	2.40	4.36	.95	1.40	6.78	9.07	26.35	76.85
39	15.20	3.96	15.45	3.00	37.61	.22	1.12	4.93	10.98	.39	17.64	1.28	.17	2.44	4.68	1.05	1.44	6.82	9.59	27.47	82.72
40	16.49	4.27	17.28	3.20	41.24	.22	1.17	5.67	12.03	.43	19.52	1.32	.20	2.51	4.97	1.17	1.50	6.75	10.09	28.51	89.27
41	17.75	4.59	18.95	3.38	44.67	.22	1.26	6.30	13.06	.50	21.34	1.37	.24	2.57	5.27	1.32	1.55	6.68	10.60	29.60	95.61
42	19.20	4.95	20.80	3.60	48.55	.22	1.35	7.13	14.06	.55	23.31	1.41	.29	2.64	5.58	1.50	1.59	6.54	11.18	30.73	102.59
43	20.49	5.40	22.70	3.80	52.39	.22	1.44	7.93	15.20	.62	25.41	1.46	.37	2.69	5.87	1.68	1.64	6.23	11.73	31.67	109.47
44	21.75	5.85	24.60	4.03	56.23	.22	1.55	8.74	16.29	.70	27.50	1.50	.43	2.75	6.16	1.95	1.68	5.79	12.30	32.56	116.29

TABLE 9.—*Volume in cubic feet contained in merchantable portion of immature trees, of different merchantable lengths and diameters breasthigh.*

(Values read from curves shown in Fig. 74.)

Diameter breast-high in inches	MERCHANTABLE LENGTH (FEET)							Height of stump, feet	Basis, No. of trees
	70	80	90	100	110	120	130		
	VOLUME IN CUBIC FEET								
20	63	74	85	97	----------	----------	----------	1.2	11
21	68	80	91	103	----------	----------	----------	1.2	
22	75	86	98	110	123	----------	----------	1.2	39
23	81	93	106	118	131	----------	----------	1.2	
24	88	100	114	127	140	----------	----------	1.3	67
25	95	108	122	136	150	----------	----------	1.3	
26	101	115	131	145	161	176	----------	1.3	92
27	----------	124	140	155	172	188	----------	1.3	
28	----------	133	150	166	183	201	220	1.3	100
29	----------	----------	160	177	196	215	236	1.3	
30	----------	----------	170	189	209	229	252	1.3	65
31	----------	----------	----------	202	222	244	268	1.3	
32	----------	----------	----------	215	236	259	285	1.4	57
33	----------	----------	----------	227	250	275	302	1.4	
34	----------	----------	----------	240	265	291	320	1.3	29
35	----------	----------	----------	----------	280	308	339	1.3	
36	----------	----------	----------	----------	295	325	358	1.4	27
37	----------	----------	----------	----------	----------	343	378	1.4	
38	----------	----------	----------	----------	----------	361	400	1.5	7
39	----------	----------	----------	----------	----------	380	420	1.5	
40	----------	----------	----------	----------	----------	400	441	1.5	8
Total number of trees									502

NOTE.—This table shows total volume in cubic feet inside bark from the stump to a height where the tree is 6″ in diameter outside the bark.

TABLE 10.—*Volume in cubic feet contained in merchantable portion of mature trees, of different merchantable lengths and diameters breasthigh.*

(Values read from curves shown in Fig. 75.)

Diameter breast-high in inches	MERCHANTABLE LENGTH (FEET)								Height of stump, feet	Basis, No. of trees
	80	90	100	110	120	130	140	150		
	VOLUME IN CUBIC FEET									
20	77	87	99	--------	--------	--------	--------	--------	1.1	3
21	85	96	107	--------	--------	--------	--------	--------	1.1	
22	93	105	116	--------	--------	--------	--------	--------	1.1	9
23	102	114	127	--------	--------	--------	--------	--------	1.1	
24	111	124	138	152	--------	--------	--------	--------	1.2	15
25	121	135	149	165	--------	--------	--------	--------	1.2	
26	131	146	162	178	194	--------	--------	--------	1.3	32
27	142	158	175	192	209	--------	--------	--------	1.3	
28	152	170	188	207	225	--------	--------	--------	1.3	39
29	--------	184	203	222	242	--------	--------	--------	1.3	
30	--------	198	218	238	259	282	--------	--------	1.3	33
31	--------	212	233	255	277	301	--------	--------	1.3	
32	--------	226	248	272	295	321	347	--------	1.4	53
33	--------	--------	264	288	314	342	368	--------	1.4	
34	--------	--------	280	307	334	363	392	424	1.4	66
35	--------	--------	297	325	354	385	415	450	1.4	
36	--------	--------	313	344	375	407	440	477	1.4	48
37	--------	--------	--------	363	397	430	466	506	1.4	
38	--------	--------	--------	384	419	454	493	535	1.4	44
39	--------	--------	--------	405	442	479	520	567	1.4	
40	--------	--------	--------	427	465	505	550	599	1.4	28
41	--------	--------	--------	--------	488	532	578	633	1.4	
42	--------	--------	--------	--------	514	559	609	669	1.5	20
43	--------	--------	--------	--------	538	587	640	705	1.5	
44	--------	--------	--------	--------	562	615	674	741	1.5	11
Total number of trees										401

NOTE.—This table shows total volume in cubic feet inside bark from the stump to a height where the tree is 6" in diameter outside the bark.

TABLE 11.—*Form factors for merchantable portion of immature western yellow pine trees, of different merchantable lengths and diameters breasthigh.*

This table compiled by substituting values given in Table 9 in the following formula:

$$\text{Form factor} = \frac{\text{Vol. cu. ft. contained in merch. lgth. inside bark}}{.7854 \div 144\ (\text{D.B.H.})^2 \times \text{merch. lgth. in feet}}$$

Diameter breast-high in inches	MERCHANTABLE LENGTH (FEET)							Height of stump, feet	Basis, No. of trees
	70	80	90	100	110	120	130		
	FORM FACTORS								
20	.412	.431	.433	.445	----------	----------	----------	1.2	11
21	.405	.417	.421	.420	----------	----------	----------	1.2	
22	.405	.407	.413	.417	.423	----------	----------	1.2	39
23	.401	.402	.408	.410	.413	----------	----------	1.2	
24	.400	.398	.403	.405	.405	----------	----------	1.3	67
25	.397	.396	.397	.399	.399	----------	----------	1.3	
26	.392	.393	.395	.393	.395	.398	----------	1.3	92
27	----------	.390	.392	.390	.390	.393	----------	1.3	
28	----------	.389	.390	.388	.388	.391	.395	1.3	100
29	----------	----------	.388	.386	.388	.390	.396	1.3	
30	----------	----------	.385	.386	.387	.388	.395	1.3	65
31	----------	----------	----------	.386	.385	.388	.394	1.3	
32	----------	----------	----------	.385	.384	.386	.392	1.4	57
33	----------	----------	----------	.383	.383	.386	.391	1.4	
34	----------	----------	----------	.381	.382	.385	.391	1.4	29
35	----------	----------	----------	----------	.381	.384	.390	1.4	
36	----------	----------	----------	----------	.379	.383	.389	1.4	27
37	----------	----------	----------	----------	----------	.382	.389	1.4	
38	----------	----------	----------	----------	----------	.381	.390	1.5	7
39	----------	----------	----------	----------	----------	.381	.389	1.5	
40	----------	----------	----------	----------	----------	.381	.388	1.5	8
Total number of trees									502

TABLE 12.—*Form factors for merchantable portion of mature western yellow pine trees, of different merchantable lengths and diameters breast high.*

This table compiled by substituting values given in Table 10 in the following formula

$$\text{Form factor} = \frac{\text{Vol. cu. ft. contained in merch. lgth. inside bark}}{.7854 \div 144\ (\text{D.B.H.})^2 \times \text{merch. lgth}}$$

Diameter breast-high in inches	MERCHANTABLE LENGTH (FEET) 80	90	100	110	120	130	140	150	Height of stump, feet	Basis, No. of trees
	FORM FACTORS									
20	.442	.443	.453	----	----	----	----	----	1.1	3
21	.442	.443	.446	----	----	----	----	----	1.1	
22	.442	.443	.440	----	----	----	----	----	1.1	9
23	.442	.445	.441	----	----	----	----	----	1.1	
24	.442	.439	.440	.440	----	----	----	----	1.2	15
25	.443	.440	.437	.439	----	----	----	----	1.2	
26	.444	.440	.439	.439	.438	----	----	----	1.3	32
27	.447	.442	.440	.439	.440	----	----	----	1.3	
28	.445	.442	.440	.439	.438	----	----	----	1.3	39
29	----	.445	.442	.440	.439	----	----	----	1.3	
30	----	.448	.444	.441	.439	.442	----	----	1.3	33
31	----	.450	.445	.441	.441	.442	----	----	1.3	
32	----	.450	.445	.442	.440	.442	.444	----	1.4	53
33	----	----	.445	.442	.440	.443	.443	----	1.4	
34	----	----	.445	.443	.442	.443	.444	.447	1.4	66
35	----	----	.445	.442	.441	.443	.444	.448	1.4	
36	----	----	.443	.442	.441	.442	.445	.450	1.4	48
37	----	----	----	.442	.443	.442	.446	.452	1.4	
38	----	----	----	.442	.442	.442	.447	.452	1.4	44
39	----	----	----	.443	.444	.444	.447	.455	1.4	
40	----	----	----	.445	.444	.445	.450	.456	1.4	28
41	----	----	----	----	.443	.446	.450	.460	1.4	
42	----	----	----	----	.444	.446	.451	.463	1.5	20
43	----	----	----	----	.444	.447	.453	.466	1.5	
44	----	----	----	----	.443	.448	.455	.468	1.5	11
Total number of trees										401

TABLE 13.—*Volume in board feet, as shown by the Spaulding Log Rule, contained in merchantable portion of immature trees of different merchantable lengths and diameters breasthigh.*

(Values read from curves shown in Fig. 76.)

Diameter breast-high in inches	MERCHANTABLE LENGTH (FEET)							Diameter inside bark top log, inches	Height of stump, feet	Basis, number of trees
	70	80	90	100	110	120	130			
	VOLUME BY SPAULDING LOG SCALE (BD. FT.)									
20	300	380	465	550	---	---	---	6.6	1.2	11
21	325	405	495	580	---	---	---	6.7	1.2	
22	350	435	530	630	730	---	---	6.7	1.2	39
23	380	475	570	680	780	---	---	6.8	1.2	
24	415	510	620	730	840	---	---	6.9	1.3	67
25	450	560	670	785	905	---	---	7.0	1.3	
26	490	605	725	845	975	1100	---	7.1	1.3	92
27	---	655	780	915	1050	1180	---	7.1	1.3	
28	---	710	845	980	1130	1270	1415	7.2	1.3	100
29	---	---	910	1060	1210	1365	1520	7.3	1.3	
30	---	---	980	1140	1300	1460	1630	7.4	1.3	65
31	---	---	---	1225	1395	1565	1750	7.5	1.3	
32	---	---	---	1310	1490	1675	1870	7.6	1.4	57
33	---	---	---	1400	1585	1780	1990	7.7	1.4	
34	---	---	---	1495	1695	1900	2125	7.8	1.3	29
35	---	---	---	---	1800	2020	2255	7.9	1.3	
36	---	---	---	---	1910	2140	2400	8.0	1.4	27
37	---	---	---	---	---	2265	2550	8.2	1.4	
38	---	---	---	---	---	2395	2700	8.5	1.5	7
39	---	---	---	---	---	2525	2850	9.0	1.5	
40	---	---	---	---	---	2660	3005	9.6	1.5	8
Total number of trees										502

TABLE 14.—*Volume in board feet, as shown by the Spaulding Log Rule, contained in merchantable portion of mature trees of different merchantable lengths and diameters breasthigh.*

(Values read from curves shown in Fig. 77.)

TABLE 14.

Diameter breast-high in inches	MERCHANTABLE LENGTH (FEET)								Diameter inside bark, top log, inches	Height of stump, feet	Basis, No. of trees
	80	90	100	110	120	130	140	150			
	VOLUME BY SPAULDING LOG SCALE (BD. FT.)										
20	355	455	570	--------	--------	--------	--------	--------	7.2	1.1	3
21	400	500	620	--------	--------	--------	--------	--------	7.4	1.1	
22	455	570	680	--------	--------	--------	--------	--------	7.6	1.1	9
23	510	630	750	--------	--------	--------	--------	--------	7.7	1.1	
24	570	695	820	945	--------	--------	--------	--------	7.9	1.2	15
25	645	770	895	1030	--------	--------	--------	--------	8.1	1.2	
26	720	850	970	1125	1270	--------	--------	--------	8.3	1.3	32
27	795	930	1070	1220	1375	--------	--------	--------	8.5	1.3	
28	875	1020	1170	1320	1480	--------	--------	--------	8.7	1.3	39
29	--------	1110	1270	1425	1600	--------	--------	--------	8.9	1.3	
30	--------	1210	1375	1535	1720	1915	--------	--------	9.1	1.3	33
31	--------	1315	1475	1650	1840	2045	--------	--------	9.3	1.3	
32	--------	1420	1580	1770	1970	2175	2400	--------	9.6	1.4	53
33	--------	--------	1695	1890	2100	2315	2550	--------	9.8	1.4	
34	--------	--------	1805	2010	2230	2455	2700	2950	10.0	1.4	66
35	--------	--------	1930	2145	2370	2610	2875	3150	10.2	1.4	
36	--------	--------	2050	2270	2510	2770	3050	3350	10.4	1.4	48
37	--------	--------	--------	2400	2655	2930	3240	3570	10.7	1.4	
38	--------	--------	--------	2530	2805	3100	3430	3800	11.0	1.4	44
39	--------	--------	--------	2670	2965	3275	3630	4080	11.2	1.4	
40	--------	--------	--------	2805	3125	3460	3840	4280	11.5	1.4	28
41	--------	--------	--------	--------	3280	3650	4060	4530	11.7	1.4	
42	--------	--------	--------	--------	3450	3850	4280	4800	12.1	1.5	20
43	--------	--------	--------	--------	3620	4050	4525	5080	12.4	1.5	
44	--------	--------	--------	--------	3795	4260	4770	5375	12.7	1.5	11
Total number of trees--											401

TABLE 15.—*Volume in board feet actually "sawed out" at mill from merchantable portion of immature trees of different merchantable lengths and diameters breast-high.*

(Values read from curves shown in Fig. 78.)

Diameter breast-high in inches	MERCHANTABLE LENGTH (FEET)							Diameter inside bark, top log, inches	Height of stump, feet	Basis, No. of trees
	70	80	90	100	110	120	130			
	VOLUME "SAWED OUT" (BOARD FEET)									
20	475	580	675	790	--------	--------	--------	6.6	1.2	11
21	520	625	730	840	--------	--------	--------	6.7	1.2	
22	560	675	790	900	1020	--------	--------	6.7	1.2	39
23	610	730	850	970	1095	--------	--------	6.8	1.2	
24	665	790	915	1045	1170	--------	--------	6.9	1.3	67
25	720	850	990	1120	1255	--------	--------	7.0	1.3	
26	780	920	1060	1200	1350	1505	--------	7.1	1.3	92
27	--------	990	1140	1285	1445	1610	--------	7.1	1.3	
28	--------	1060	1220	1380	1545	1730	1920	7.2	1.3	100
29	--------	--------	1315	1480	1650	1845	2050	7.3	1.3	
30	--------	--------	1400	1585	1760	1965	2195	7.4	1.3	65
31	--------	--------	--------	1685	1875	2090	2340	7.5	1.3	
32	--------	--------	--------	1795	2000	2225	2490	7.6	1.4	57
33	--------	--------	--------	1900	2120	2365	2645	7.7	1.4	
34	--------	--------	--------	2005	2250	2500	2800	7.8	1.3	29
35	--------	--------	--------	--------	2380	2650	2960	7.9	1.3	
36	--------	--------	--------	--------	2500	2795	3130	8.0	1.4	27
37	--------	--------	--------	--------	--------	2945	3300	8.2	1.4	
38	--------	--------	--------	--------	--------	3100	3480	8.5	1.5	7
39	--------	--------	--------	--------	--------	3250	3660	9.0	1.5	
40	--------	--------	--------	--------	--------	3400	3850	9.6	1.5	8
Total number of trees										502

TABLE 16.—*Volume in board feet actually "sawed out" at mill from merchantable portion of mature trees of different merchantable lengths and diameters breasthigh.*

(Values read from curves shown in Fig. 79.)

Diameter breast-high in inches	MERCHANTABLE LENGTH (FEET)							Diameter inside bark, top log, inches	Height of stump, feet	Basis, No. of trees
	80	90	100	110	120	130	140	150			
	VOLUME "SAWED OUT" (BOARD FEET)										
20	550	680	825	--------	--------	--------	--------	--------	7.2	1.1	3
21	610	760	905	--------	--------	--------	--------	--------	7.4	1.1	
22	680	840	985	--------	--------	--------	--------	--------	7.6	1.1	9
23	730	920	1075	--------	--------	--------	--------	--------	7.7	1.1	
24	840	1005	1165	1345	--------	--------	--------	--------	7.9	1.2	15
25	925	1095	1260	1440	--------	--------	--------	--------	8.1	1.2	
26	1020	1190	1370	1550	1750	--------	--------	--------	8.3	1.3	32
27	1120	1295	1480	1665	1875	--------	--------	--------	8.5	1.3	
28	1220	1400	1595	1795	2010	--------	--------	--------	8.7	1.3	39
29	--------	1515	1710	1925	2145	--------	--------	--------	8.9	1.3	
30	--------	1625	1835	2060	2290	2530	--------	--------	9.1	1.3	33
31	--------	1745	1960	2200	2435	2690	--------	--------	9.3	1.3	
32	--------	1860	2090	2335	2590	2850	3140	--------	9.6	1.4	53
33	--------	--------	2220	2480	2750	3025	3325	--------	9.8	1.4	
34	--------	--------	2360	2620	2900	3200	3520	3850	10.0	1.4	66
35	--------	--------	2500	2770	3070	3385	3725	4075	10.2	1.4	
36	--------	--------	2645	2925	3235	3580	3930	4320	10.4	1.4	48
37	--------	--------	--------	3080	3400	3770	4155	4570	10.7	1.4	
38	--------	--------	--------	3245	3585	3975	4380	4825	11.0	1.4	44
39	--------	--------	--------	3400	3770	4185	4620	5085	11.2	1.4	
40	--------	--------	--------	3575	3960	4400	4860	5360	11.5	1.4	28
41	--------	--------	--------	--------	4150	4620	5120	5650	11.7	1.4	
42	--------	--------	--------	--------	4350	4845	5370	5945	12.1	1.5	20
43	--------	--------	--------	--------	4550	5075	5635	6240	12.4	1.5	
44	--------	--------	--------	--------	4750	5315	5910	6550	12.7	1.5	11
Total number of trees											401

TABLE 17.—*Value in dollars and cents of lumber actually "sawed out" at mill from merchantable portion of immature trees of different merchantable lengths and diameters breasthigh.*

(This table compiled by applying the "value per 1000 board feet determinations," given in Fig. 70, Curve "C," to Table 15.)

Diameter breast-high in inches	MERCHANTABLE LENGTH (FEET)							Diameter inside bark, top log, inches	Height of stump, feet	Basis, No. of trees
	70	80	90	100	110	120	130			
	VALUE IN DOLLARS AND CENTS									
20	7.00	8.50	9.90	11.60	--------	--------	--------	6.6	1.2	11
21	7.70	9.30	10.80	12.50	--------	--------	--------	6.7	1.2	
22	8.40	10.10	11.80	13.50	15.30	--------	--------	6.7	1.2	39
23	9.20	11.10	12.90	14.70	16.60	--------	--------	6.8	1.2	
24	10.20	12.10	14.00	16.00	18.00	--------	--------	6.9	1.3	67
25	11.20	13.20	15.40	17.40	19.50	--------	--------	7.0	1.3	
26	12.30	14.50	16.70	18.90	21.10	23.70	--------	7.1	1.3	92
27	--------	15.90	18.30	20.00	23.20	25.80	--------	7.1	1.3	
28	--------	17.30	19.90	22.60	25.30	28.30	31.40	7.2	1.3	100
29	--------	--------	21.80	24.60	27.40	30.70	34.00	7.3	1.3	
30	--------	--------	23.60	26.70	29.60	33.10	37.00	7.4	1.3	65
31	--------	--------	--------	28.80	32.00	35.80	40.00	7.5	1.3	
32	--------	--------	--------	31.00	34.60	38.50	43.10	7.6	1.4	57
33	--------	--------	--------	33.20	37.10	41.40	46.30	7.7	1.4	
34	--------	--------	--------	35.60	39.80	44.20	49.60	7.8	1.3	29
35	--------	--------	--------	--------	42.60	47.50	53.00	7.9	1.3	
36	--------	--------	--------	--------	45.20	50.50	56.50	8.0	1.4	27
37	--------	--------	--------	--------	--------	53.80	60.20	8.2	1.4	
38	--------	--------	--------	--------	--------	57.00	64.00	8.5	1.5	7
39	--------	--------	--------	--------	--------	60.30	68.00	9.0	1.5	
40	--------	--------	--------	--------	--------	63.60	72.00	9.6	1.5	8
Total number of trees										502

Table 18.—*Value in dollars and cents of lumber actually "sawed out" at mill from merchantable portion of mature trees of different merchantable lengths and diameters breasthigh.*

(This table compiled by applying the "value per 1000 board feet determination," given in Fig. 72, Curve "C,", to Table 16.)

Diameter breast-high in inches	MERCHANTABLE LENGTH (FEET)								Diameter inside bark, top log, inches	Height of stump, feet	Basis, No. of trees
	80	90	100	110	120	130	140	150			
	VALUE IN DOLLARS AND CENTS										
20	8.30	10.40	12.60	-------	-------	-------	-------	-------	7.2	1.1	3
21	9.50	11.80	14.00	-------	-------	-------	-------	-------	7.4	1.1	
22	10.70	13.10	15.60	-------	-------	-------	-------	-------	7.6	1.1	9
23	12.20	14.80	17.30	-------	-------	-------	-------	-------	7.7	1.1	
24	13.70	16.70	19.00	21.40	-------	-------	-------	-------	7.9	1.2	15
25	15.30	18.10	20.80	23.40	-------	-------	-------	-------	8.1	1.2	
26	17.10	20.00	23.00	26.00	29.40	-------	-------	-------	8.3	1.3	32
27	19.10	22.10	25.20	28.40	32.00	-------	-------	-------	8.5	1.3	
28	21.00	24.20	27.50	31.00	34.70	-------	-------	-------	8.7	1.3	39
29	-------	26.50	29.90	33.70	37.60	-------	-------	-------	8.9	1.3	
30	-------	28.80	32.50	36.50	40.50	44.80	-------	-------	9.1	1.3	33
31	-------	31.10	35.10	39.40	43.70	48.20	-------	-------	9.3	1.3	
32	-------	33.70	37.80	42.30	46.80	51.60	56.80	-------	9.6	1.4	53
33	-------	-------	40.60	45.40	50.30	55.80	61.30	-------	9.8	1.4	
34	-------	-------	43.70	48.50	53.70	59.20	65.10	71.20	10.0	1.4	66
35	-------	-------	46.70	51.80	57.30	63.20	69.50	76.00	10.2	1.4	
36	-------	-------	49.60	54.90	60.60	67.10	73.70	81.00	10.4	1.4	48
37	-------	-------	-------	58.20	64.30	71.20	78 50	86.50	10.7	1.4	
38	-------	-------	-------	61.70	68.20	75.50	83.30	91.70	11.0	1.4	44
39	-------	-------	-------	65.10	72.20	80.10	88.50	97.50	11.2	1.4	
40	-------	-------	-------	67.90	76.20	84.70	93.50	103.20	11.5	1.4	28
41	-------	-------	-------	-------	80.40	89.50	99.10	109.20	11.7	1.4	
42	-------	-------	-------	-------	84.70	94.40	104.80	115.70	12.1	1.5	20
43	-------	-------	-------	-------	88.70	99.00	109.90	121.60	12.4	1.5	
44	-------	-------	-------	-------	92.90	104.00	115.60	128.10	12.7	1.5	11
Total number of trees											401

TABLE 19.—*Average volume sawed out by grades from merchantable portion of immature trees of different merchantable lengths and diameters breasthigh.*

Diameter breasthigh in inches	MERCHANTABLE LENGTH (FEET)																				
	70			80			90			100			110			120			130		
	VOLUME SAWED OUT BY GRADES (BOARD FEET)																				
	High	*Int.*	**Low*	*High*	*Int.*	*Low*	*High*	*Int.*	*Low*	*High*	*Int.*	*Low*	*High*	*Int.*	*Low*	*High*	*Int.*	*Low*	*High*	*Int.*	*Low*
20	20	65	390	25	80	475	29	94	552	33	110	647	------	------	------	------	------	------	------	------	------
21	28	74	418	33	89	503	39	104	587	45	120	675	------	------	------	------	------	------	------	------	------
22	34	83	443	41	100	534	48	117	625	55	183	712	62	151	807	------	------	------	------	------	------
23	43	95	472	52	113	565	61	132	657	69	151	750	78	170	847	------	------	------	------	------	------
24	54	107	504	64	127	599	75	146	694	85	167	793	96	188	886	------	------	------	------	------	------
25	66	118	536	79	139	632	92	162	736	103	184	833	116	205	934	------	------	------	------	------	------
26	83	130	567	98	154	668	113	177	770	128	200	872	144	226	980	160	252	1098	------	------	------
27	------	------	------	122	171	697	140	196	804	157	222	906	177	249	1019	197	278	1135	------	------	------
28	------	------	------	148	187	725	171	216	833	193	244	943	216	274	1055	242	306	1182	269	339	1812
29	------	------	------	------	------	------	200	240	875	225	270	985	250	302	1098	280	337	1228	311	375	1364
30	------	------	------	------	------	------	233	263	904	264	298	1023	294	331	1185	328	369	1268	366	413	1416
31	------	------	------	------	------	------	------	------	------	308	323	1059	338	360	1177	376	402	1312	421	449	1470
32	------	------	------	------	------	------	------	------	------	349	352	1094	389	393	1218	433	437	1355	484	488	1518
33	------	------	------	------	------	------	------	------	------	389	386	1125	434	432	1254	484	483	1398	542	538	1565
34	------	------	------	------	------	------	------	------	------	433	420	1152	485	472	1298	540	524	1436	605	587	1608
35	------	------	------	------	------	------	------	------	------	------	------	------	538	516	1326	598	574	1478	669	641	1650
36	------	------	------	------	------	------	------	------	------	------	------	------	594	559	1347	665	625	1506	745	700	1685
37	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	725	685	1535	812	768	1720
38	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	795	749	1556	892	840	1748
39	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	860	816	1574	968	919	1778
40	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	927	885	1588	1050	1002	1798

NOTE.—The diameter inside bark, height of stump, and basis are same as in Table No. 17.

*For classification of high, intermediate, and low grades, see Table 3.

TABLE 20.—*Average volume sawed out by grades from merchantable portion of mature trees of different merchantable lengths and diameters breasthigh.*

Diameter breasthigh in inches	MERCHANTABLE LENGTH (FEET)																							
	80			90			100			110			120			130			140			150		
	VOLUME SAWED OUT BY GRADES (BOARD FEET)																							
	High	*Int.*	**Low*	*High*	*Int.*	*Low*	*High*	*Int.*	*Low*	*High*	*Int.*	*Low*	*High*	*Int.*	*Low*	*High*	*Int.*	*Low*	*High*	*Int.*	*Low*	*High*	*Int.*	*Low*
20	51	60	439	64	76	550	77	92	666	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
21	58	68	484	72	84	604	86	101	718	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
22	90	76	514	110	93	627	130	110	745	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
23	106	90	564	128	109	683	150	127	798	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
24	128	103	609	153	123	729	177	143	845	205	164	976	------	------	------	------	------	------	------	------	------	------	------	------
25	149	120	656	176	142	777	208	163	894	232	186	1022	------	------	------	------	------	------	------	------	------	------	------	------
26	176	139	705	206	162	822	237	187	946	268	211	1071	302	238	1210	------	------	------	------	------	------	------	------	------
27	208	161	751	241	186	868	275	212	993	309	239	1117	348	269	1258	------	------	------	------	------	------	------	------	------
28	242	185	793	278	212	910	316	241	1038	356	272	1167	398	304	1308	------	------	------	------	------	------	------	------	------
29	------	------	------	318	242	955	359	273	1078	404	307	1214	450	342	1353	------	------	------	------	------	------	------	------	------
30	------	------	------	360	272	993	406	307	1122	456	344	1260	506	382	1402	559	423	1548	------	------	------	------	------	------
31	------	------	------	408	304	1033	458	342	1160	514	384	1302	569	425	1441	628	470	1592	------	------	------	------	------	------
32	------	------	------	454	334	1072	511	376	1203	571	420	1344	633	466	1491	696	518	1641	766	565	1809	------	------	------
33	------	------	------	------	------	------	564	418	1238	630	468	1382	698	518	1534	768	570	1687	845	627	1853	------	------	------
34	------	------	------	------	------	------	620	466	1274	688	514	1418	763	569	1568	841	627	1732	926	690	1904	1012	755	2083
35	------	------	------	------	------	------	677	512	1311	750	568	1452	830	630	1610	916	694	1775	1009	764	1952	1102	835	2138
36	------	------	------	------	------	------	742	564	1339	820	624	1481	907	690	1688	1004	764	1812	1102	838	1990	1210	922	2188
37	------	------	------	------	------	------	------	------	------	887	681	1512	979	751	1670	1086	834	1850	1196	918	2041	1317	1010	2248
38	------	------	------	------	------	------	------	------	------	961	738	1546	1061	814	1710	1175	904	1896	1295	996	2090	1426	1099	2300
39	------	------	------	------	------	------	------	------	------	1022	798	1580	1134	885	1751	1260	980	1945	1389	1083	2148	1530	1193	2362
40	------	------	------	------	------	------	------	------	------	1100	865	1610	1218	958	1784	1353	1064	1983	1495	1177	2188	1650	1298	2412
41	------	------	------	------	------	------	------	------	------	------	------	------	1300	1030	1820	1447	1147	2026	1603	1270	2247	1770	1402	2478
42	------	------	------	------	------	------	------	------	------	------	------	------	1384	1104	1862	1540	1230	2075	1710	1368	2297	1890	1510	2545
43	------	------	------	------	------	------	------	------	------	------	------	------	1472	1187	1891	1642	1323	2110	1820	1470	2345	2020	1628	2592
44	------	------	------	------	------	------	------	------	------	------	------	------	1560	1270	1920	1743	1420	2152	1940	1580	2390	2150	1750	2650

NOTE.—The diameter inside bark, height of stump, and basis are same as in Table No. 18.

*For classification of high, intermediate, and low grades, see Table 4.

TABLE 21.—*Growth in volume and value of immature western yellow pine.*

(Values read from curves shown in Figs. 4, 11, 68, 70, 87, 88, 91 and 92.)

Diameter breast-high in inches	Average merch. length in feet	Volume in board feet	Value per tree	Average value per 1000 bd. ft.	Increase in volume (board feet) per decade			% increase in volume per decade			Increase in value per decade			% increase in value per decade		
					Lowest 10%	Average	Highest 10%	Lowest 10%	Average	Highest 10%	Lowest 10%	Average	Highest 10%	Lowest 10%	Average	Highest 10%
20	84	685	$10.10	$14.75	20	50	82	3.1	7.4	11.8	$.40	$.80	$1.15	3.9	7.4	10.8
21	87	735	10.90	14.85	22	55	88	3.1	7.5	12.1	.40	.85	1.25	3.9	7.6	11.8
22	89	790	11.85	15.00	25	65	105	3.3	8.0	12.8	.45	1.00	1.60	4.0	8.4	13.2
23	91	870	13.00	15.15	30	80	130	3.5	8.8	14.2	.55	1.30	2.00	4.1	9.7	14.8
24	94	955	14.65	15.35	37	97	160	4.0	9.9	16.2	.65	1.45	2.60	4.4	11.5	17.3
25	96	1060	16.30	15.55	46	116	190	4.4	10.8	17.8	.80	2.15	3.30	4.7	12.9	19.9
26	99	1175	18.50	15.75	54	136	223	4.8	11.5	18.9	1.00	2.55	4.00	5.3	13.7	21.5
27	101	1300	20.70	16.05	64	155	253	5.1	12.0	19.4	1.25	2.95	4.70	6.0	14.0	22.2
28	104	1445	23.60	16.35	73	174	282	5.2	12.3	19.5	1.45	3.35	5.30	6.3	14.0	22.4
29	106	1585	26.50	16.60	82	194	310	5.2	12.3	19.4	1.65	3.70	5.90	6.4	13.8	22.2
30	108	1755	29.55	16.85	89	210	340	5.0	12.0	19.2	1.85	4.00	6.50	6.3	13.5	21.7
31	110	1925	33.00	17.10	95	226	366	4.8	11.7	18.6	2.00	4.35	7.00	6.0	13.0	21.0
32	112	2115	36.65	17.30	100	238	388	4.6	11.2	18.0	2.10	4.60	7.45	5.6	12.4	20.3
33	115	2315	40.60	17.50	104	246	405	4.4	10.5	17.2	2.15	4.80	7.85	5.2	11.7	19.2
34	117	2525	44.75	17.70	105	250	418	4.1	9.8	16.3	2.20	4.95	8.20	4.7	11.0	18.2
35	119	2735	48.90	17.90	105	250	422	3.8	9.2	15.3	2.15	5.05	8.45	4.3	10.3	17.0
36	121	2960	53.50	18.05	103	249	422	3.5	8.4	14.2	2.10	5.10	8.60	3.8	9.5	15.9
37	123	3160	57.75	18.25	99	246	420	3.1	7.7	13.1	2.00	5.05	8.70	3.4	8.7	14.8
38	125	3380	62.30	18.40	92	240	415	2.8	7.0	12.1	1.90	5.00	8.65	3.0	8.0	13.7
39	127	3600	66.90	18.55	84	233	410	2.4	6.4	11.1	1.80	4.95	8.45	2.7	7.8	12.7
40	129	3825	71.45	18.70	75	224	402	2.0	5.8	10.2	1.70	4.75	8.25	2.3	6.6	11.6
41	131	4040	76.00	18.85	65	214	390	1.6	5.2	9.5	1.55	4.55	8.00	2.0	5.9	10.6
42	133	4260	80.60	18.95	54	203	380	1.2	4.6	8.8	1.40	4.25	7.70	1.7	5.2	9.5

TABLE 22.—*Growth in volume and value of mature western yellow pine.*

(Values read from curves shown in Figs. 5, 13, 69, 72, 89, 90, 93 and 94.)

Diameter breast-high in inches	Average merch. length in feet	Volume in board feet	Value per tree	Average value per 1000 bd. ft.	Increase in volume (board feet) per decade			% increase in volume per decade			Increase in value per decade			% increase in value per decade		
					Lowest 10%	Average	Highest 10%	Lowest 10%	Average	Highest 10%	Lowest 10%	Average	Highest 10%	Lowest 10%	Average	Highest 10%
20	83	625	$9.50	$15.10	15	31	48	2.3	5.0	7.7	$.25	$.60	$.87	2.7	6.0	9.2
21	87	715	11.00	15.50	16	34	55	2.4	5.1	7.9	.30	.68	1.00	2.7	6.0	9.4
22	91	820	13.00	15.80	19	40	66	2.4	5.2	8.1	.35	.72	1.25	2.8	6.2	9.6
23	94	930	15.00	16.05	22	50	80	2.5	5.4	8.5	.42	.95	1.50	2.8	6.4	10.1
24	97	1060	17.30	16.30	28	60	96	2.6	5.7	9.0	.50	1.15	1.85	2.9	6.6	10.6
25	100	1200	20.00	16.55	34	71	113	2.7	5.9	9.4	.55	1.35	2.20	2.9	6.7	11.0
26	103	1360	22.75	16.80	40	82	131	2.9	6.0	9.6	.65	1.60	2.55	3.0	6.8	11.2
27	105	1525	26.00	17.05	45	92	149	3.0	6.0	9.7	.75	1.80	2.90	3.0	6.8	11.2
28	107	1700	29.40	17.25	50	101	166	3.0	6.0	9.7	.87	2.00	3.27	3.0	6.7	11.0
29	110	1880	32.90	17.50	55	110	183	3.0	6.0	9.6	1.00	2.20	3.60	3.0	6.6	10.9
30	112	2080	36.80	17.70	60	120	200	2.9	5.9	9.5	1.10	2.38	4.00	3.0	6.5	10.7
31	114	2290	40.75	17.90	64	130	216	2.8	5.8	9.4	1.18	2.58	4.30	2.9	6.3	10.5
32	117	2500	45.10	18.10	69	139	232	2.7	5.6	9.3	1.25	2.75	4.60	2.8	6.1	10.2
33	119	2735	49.60	18.30	72	148	248	2.6	5.5	9.1	1.33	2.90	4.90	2.7	5.9	9.9
34	121	2970	54.60	18.50	75	155	263	2.5	5.3	8.8	1.40	3.08	5.20	2.6	5.7	9.5
35	123	3220	59.75	18.65	78	162	277	2.4	5.1	8.6	1.45	3.20	5.50	2.4	5.4	9.2
36	125	3480	65.40	18.75	80	169	290	2.2	4.9	8.3	1.50	3.35	5.75	2.3	5.2	8.8
37	127	3750	71.00	18.90	80	175	303	2.1	4.7	8.0	1.55	3.50	6.00	2.2	5.0	8.4
38	129	4030	76.85	19.00	80	180	314	2.0	4.5	7.7	1.58	3.65	6.20	2.1	4.7	8.0
39	131	4320	83.00	19.15	81	184	322	1.9	4.3	7.4	1.62	3.75	6.35	2.0	4.5	7.7
40	133	4625	89.25	19.25	82	188	328	1.8	4.0	7.1	1.66	3.85	6.50	1.9	4.3	7.3
41	135	4940	95.80	19.35	82	190	330	1.7	3.8	6.7	1.70	3.92	6.60	1.8	4.1	6.9
42	137	5270	102.50	19.45	82	190	332	1.6	3.6	6.3	1.73	4.00	6.70	1.7	3.8	6.5
43	138	5590	109.30	19.50	82	190	332	1.5	3.4	6.0	1.73	4.03	6.72	1.6	3.6	6.2
44	140	5930	116.25	19.55	82	191	332	1.4	3.2	5.6	1.73	4.05	6.73	1.5	3.4	5.8

AVERAGE VALUES FOR 16′ BUTT LOGS.

TABLE 23.—*Volume in board feet of each grade actually "sawed out" at mill from 16′ butt logs of immature western yellow pine trees of different diameters breasthigh.*

(Values read from curves shown on left-hand pages, Nos. 90 to 100, inclusive.)

Diameter breasthigh in inches	HIGH GRADES					INTERMEDIATE GRADES						LOW GRADES									Total sawed out, all grades
	C. & Bet. 6/4	Mldg. Stock	No. 1 Shop 6/4	D. Sel. & Bet. 1″	Total	No. 1* Com. 1″	No. 2 Com. 1″	Shop 1″	No. 2 Shop 6/4	Shims	Total	Box 1″	Cull 2″	Box 6/4	No. 3 Shop 6/4	No. 3 Com. 1″	Plank 3″	4x4 & Lgr.	2x4 & wider No. 1 Dim.	Total	
	a′ +	b′ +	c′ +	d′ =	Av′	e′ +	f′ +	g′ +	h′ +	i′ =	Bv′	j′ +	k′ +	l′ +	m′ +	n′ +	o′ +	p′ +	q′ =	Cv′	A′
20	3	9	4	7	23	10	11	7	7	3	38	13	5	35	18	9	7	11	50	148	209
21	5	10	5	10	30	10	12	7	13	3	45	12	5	34	23	9	7	11	52	153	228
22	8	11	6	12	37	10	12	7	20	4	53	11	5	34	27	9	7	11	54	158	248
23	12	12	8	15	47	10	13	7	27	4	61	10	5	33	28	9	7	11	57	160	268
24	17	13	12	18	60	10	13	7	32	5	67	10	5	33	31	9	7	12	60	167	294
25	24	15	16	20	75	10	14	8	37	5	74	9	5	32	32	9	7	12	62	168	317
26	31	16	21	22	90	10	15	8	41	5	79	9	5	32	33	9	7	12	65	170	339
27	41	18	28	25	112	10	15	9	46	6	86	8	5	31	34	10	7	12	68	175	373
28	50	20	35	28	133	10	16	9	50	6	91	8	5	30	34	10	7	13	70	177	401
29	62	21	41	30	154	10	17	10	54	7	98	7	5	30	33	10	7	14	72	178	430
30	76	22	50	32	180	10	17	10	56	7	100	7	5	30	33	10	7	16	76	184	464
31	88	24	57	35	204	9	18	10	58	7	102	7	6	29	32	10	7	17	82	190	496
32	101	26	65	37	229	9	18	11	59	8	105	6	7	29	31	10	7	18	85	193	527
33	114	28	75	39	256	9	19	14	60	8	110	6	8	28	30	10	7	20	90	199	565
34	132	30	84	41	287	9	20	20	60	8	117	6	9	28	28	10	7	20	96	204	608
35	150	32	93	42	317	9	20	28	61	9	127	6	10	27	26	11	7	20	101	208	652
36	166	34	102	44	346	8	20	38	61	9	136	6	11	27	24	11	7	20	105	211	698
37	182	36	113	45	376	8	21	51	61	9	150	6	13	26	23	11	7	19	108	213	739
38	198	39	121	47	405	8	21	67	61	10	167	6	16	25	22	11	6	18	107	211	783
39	217	41	132	49	439	7	21	85	60	12	185	6	18	25	20	11	6	16	104	206	830
40	236	43	142	50	471	7	22	103	60	14	206	6	20	24	19	11	6	14	101	201	879
41	250	46	158	51	500	7	22	126	60	17	232	6	23	24	18	11	6	12	97	197	929
42	266	50	168	52	531	7	23	148	59	21	258	6	26	23	16	11	6	9	91	188	977

TABLE 24.—*Volume in board feet of each grade actually "sawed out" at mill from 16' butt logs of mature western yellow pine trees of different diameters breasthigh.*

(Values read from curves shown on right-hand pages Nos. 91 to 101, inclusive.)

Diameter breasthigh in inches	HIGH GRADES					INTERMEDIATE GRADES						LOW GRADES									Total sawed out, all grades
	C. & Bet. 6/4	Mldg. Stock	No. 1 Shop 6/4	D. Sel. & Bet. 1"	Total	No. 1 Com. 1"	No. 2 Com. 1"	Shop 1"	No. 2 Shop 6/4	Shims	Total	Box 1"	Cull 2"	Box 6/4	No. 3 Shop 6/4	No. 3 Com. 1"	Plank 3"	4x4 & Lgr.	2x4 & wider No. 1 Dim.	Total	
	$a_1' +$	$b_1' +$	$c_1' +$	$d_1' =$	Av_1'	$e_1' +$	$f_1' +$	$g_1' +$	$h_1' +$	$i_1' =$	Bv_1'	$j_1' \div$	$k_1' +$	$l_1' +$	$m_1' +$	$n_1' +$	$o_1' +$	$p_1' +$	$p_1' =$	Cv_1'	A'_1
20	0	13	16	10	39	7	11	4	10	4	36	9	7	42	18	10	0	3	45	134	209
21	11	14	18	13	56	7	11	5	11	4	38	9	7	41	18	10	0	3	52	140	234
22	21	16	20	16	73	6	11	5	12	4	38	9	7	41	18	10	0	4	60	149	260
23	33	17	23	18	91	6	11	6	13	4	40	9	7	40	18	10	0	4	67	155	286
24	46	18	26	21	111	6	11	6	15	4	42	9	7	39	18	10	0	5	73	161	314
25	56	20	29	24	129	5	11	7	17	5	45	9	7	39	19	10	0	6	80	170	344
26	68	21	32	27	148	5	11	8	20	5	49	9	8	38	19	10	0	7	86	177	374
27	81	22	36	30	169	5	11	9	23	5	53	9	8	38	20	11	0	8	91	183	405
28	96	23	40	32	191	5	11	10	26	5	57	9	8	37	20	11	0	9	97	191	439
29	109	24	43	34	210	4	11	11	30	6	62	9	9	36	20	11	0	10	102	197	469
30	122	25	47	36	230	4	11	13	34	6	68	9	9	35	20	11	0	11	107	202	500
31	137	27	51	38	253	4	11	17	38	6	76	9	9	34	21	11	0	12	110	206	535
32	151	28	56	41	276	4	11	22	43	7	87	9	10	33	21	11	0	15	113	212	575
33	166	30	63	43	302	4	11	29	48	7	99	9	10	32	23	11	0	18	116	219	620
34	180	32	70	45	327	4	11	36	54	7	112	9	10	31	24	11	0	21	117	223	662
35	195	34	78	47	354	3	11	44	57	8	123	9	10	30	26	12	0	24	117	228	705
36	210	36	85	49	380	3	11	53	63	9	139	9	10	29	29	12	0	28	116	233	752
37	224	38	94	51	407	3	11	64	69	9	156	9	11	29	31	12	0	32	113	237	800
38	239	40	102	53	434	3	11	75	73	10	172	9	11	28	33	12	0	36	109	238	844
39	253	43	114	55	465	3	11	88	80	10	192	9	11	28	36	12	0	39	101	236	893
40	269	46	128	57	500	3	12	100	85	11	211	9	12	27	38	13	0	43	93	235	946
41	284	49	144	58	535	3	12	113	91	11	230	9	13	26	40	13	0	47	83	231	996
42	301	52	162	59	574	3	13	128	97	12	256	9	15	25	42	13	0	51	70	225	1052
43	320	55	184	60	619	3	14	143	104	12	276	9	18	24	45	13	0	56	57	222	1137
44	338	59	206	60	663	3	14	159	110	13	299	9	21	23	48	13	0	62	44	220	1182

TABLE 25.—*Grades sawed from 16' butt logs of immature trees of different diameters breasthigh, expressed in per cent of total sawed out*

(Values in this table obtained as indicated by $\frac{100a'}{A'} + \frac{100b'}{A'} +$ etc. Curves Ap', Bp', and Cp' shown in Figs 139, 140 and 141.)

Diameter breasthigh in inches	HIGH GRADES					INTERMEDIATE GRADES						LOW GRADES									Total sawed out all grades
	C. & Bet. 6/4	Mldg. Stock	No. 1 Shop 6/4	D. Sel. & Bet. 1"	Total	No. 1 Com. 1"	No. 2 Com. 1"	Shop 1"	No. 2 Shop 6/4	Shims	Total	Box 1"	Cull 2"	Box 4/4	No. 3 Shop 4/4	No. 3 Com 1"	Plank 2"	1x4 & 1x6	2x4 & wider No. 1 Dim	Total	
	$\frac{100a'}{A'}+$	$\frac{100b'}{A'}+$	$\frac{100c'}{A'}+$	$\frac{100d'}{A'}$	Ap'	$\frac{100e'}{A'}+$	$\frac{100f'}{A'}+$	$\frac{100g'}{A'}+$	$\frac{100h'}{A'}+$	$\frac{100i'}{A'}$	Bp'	$\frac{100j'}{A'}+$	$\frac{100k'}{A}+$	$\frac{100l}{A}+$	$\frac{100m'}{A'}+$	$\frac{100n}{A}+$	$\frac{100o'}{A}+$	$\frac{100p}{A}+$	$\frac{100q}{A'}$	Cp	A
20	1.4	4.4	1.9	3.4	11.1	4.8	5.3	3.4	3.3	1.4	18.2	6.2	2.4	16.7	8.6	4.3	3.3	5.3	23.9	70.7	190
21	2.2	4.4	2.1	4.4	13.1	4.4	5.3	3.1	5.7	1.3	19.8	5.3	2.2	14.9	10.1	3.9	3.1	4.8	22.8	67.1	218
22	3.2	4.4	2.4	4.8	14.8	4.0	4.8	2.8	8.1	1.6	21.3	4.1	2.1	13.7	10.9	3.7	2.9	4.4	21.8	63.9	245
23	4.5	4.5	3.0	5.6	17.6	3.7	4.8	2.6	10.1	1.5	22.7	3.7	1.9	12.3	10.4	3.4	2.6	4.1	21.3	59.7	268
24	5.8	4.4	4.1	6.1	20.4	3.4	4.4	2.4	10.9	1.7	22.8	3.4	1.7	11.3	10.5	3.1	2.4	4.1	20.4	56.8	294
25	7.6	4.7	5.0	6.3	23.6	3.2	4.4	2.5	11.7	1.6	23.4	2.8	1.6	10.1	10.1	2.8	2.2	3.8	19.6	53.0	317
26	9.1	4.7	6.2	6.4	26.4	2.9	4.4	2.3	12.0	1.5	23.1	2.6	1.5	9.4	9.7	2.6	2.1	3.5	19.1	50.5	340
27	11.0	4.8	7.5	6.7	30.0	2.7	4.1	2.4	12.3	1.6	23.1	2.1	1.3	8.3	9.1	2.7	1.9	3.2	18.3	46.9	361
28	12.5	5.0	8.7	7.0	33.2	2.5	4.0	2.2	12.5	1.5	22.7	2.0	1.2	7.5	8.5	2.5	1.7	3.2	17.5	44.1	401
29	14.4	4.9	9.4	7.0	35.7	2.3	4.0	2.3	12.6	1.5	22.7	1.6	1.2	7.0	7.8	2.3	1.6	3.3	16.8	41.6	430
30	16.4	4.7	10.8	6.9	38.8	2.1	3.7	2.1	12.1	1.5	21.5	1.5	1.2	6.5	7.1	2.1	1.5	3.4	16.4	39.7	464
31	17.8	4.8	11.5	7.1	41.2	1.8	3.6	2.0	11.7	1.4	20.5	1.4	1.2	5.8	6.5	2.0	1.4	3.4	16.6	38.3	491
32	19.2	4.9	12.3	7.0	43.4	1.7	3.4	2.1	11.2	1.5	19.9	1.2	1.3	5.5	5.9	1.9	1.3	3.4	16.2	36.7	517
33	20.2	5.0	13.3	6.9	45.4	1.6	3.3	2.5	10.6	1.4	19.4	1.1	1.4	5.0	5.3	1.8	1.2	3.5	15.9	35.2	545
34	21.8	4.9	13.8	6.7	47.2	1.5	3.3	3.3	9.9	1.3	19.3	1.0	1.5	4.6	4.6	1.6	1.1	3.3	15.8	33.5	578
35	23.0	4.9	14.3	6.4	48.6	1.4	3.1	4.3	9.4	1.4	19.6	0.9	1.5	4.1	4.0	1.6	1.1	3.1	15.5	31.8	632
36	23.9	4.9	14.7	6.3	49.8	1.2	2.9	5.5	8.8	1.3	19.7	0.9	1.6	3.9	3.5	1.6	1.0	2.9	15.1	30.5	681
37	24.3	4.9	15.3	6.2	50.7	1.1	2.8	6.9	8.3	1.3	20.4	0.8	1.8	3.6	3.1	1.5	0.9	2.6	14.6	28.9	730
38	25.3	4.9	15.4	6.0	51.6	1.0	2.7	8.6	7.8	1.3	21.4	0.8	2.0	3.2	2.8	1.4	0.8	2.3	13.7	27.0	781
39	26.2	4.9	15.9	5.9	52.9	0.9	2.5	10.2	7.2	1.5	22.3	0.7	2.2	3.0	2.4	1.3	0.7	2.0	12.5	24.8	830
40	26.9	4.9	16.2	5.7	53.7	0.8	2.5	11.7	6.8	1.6	23.4	0.7	2.3	2.7	2.2	1.2	0.7	1.6	11.5	22.9	870
41	26.9	5.0	16.4	5.5	53.8	0.8	2.4	13.6	6.4	1.8	25.0	0.6	2.5	2.6	1.9	1.2	0.6	1.3	10.5	21.2	920
42	27.2	5.1	16.7	5.3	54.3	0.7	2.4	15.2	6.0	2.2	26.5	0.6	2.7	2.4	1.6	1.1	0.6	0.9	9.3	19.2	977

TABLE 26 —*Grades sawed from 16′ butt logs of mature trees of different diameters breasthigh, expressed in per cent of total sawed out.*

(Values in this table obtained as indicated by $\frac{100a_1'}{A_1'} + \frac{100b_1'}{A_1'}$ + etc. Curves Ap_1', Bp_1' and Cp_1' shown in Figs. 142, 143 and 144.)

Diameter breasthigh in inches	HIGH GRADES					INTERMEDIATE GRADES						LOW GRADES									Total sawed out, all grades
	C. & Bet. 6/4	Mldg. Stock	No. 1 Shop 6/4	D. Sel. & Bet. 1″	Total	No. 1 Com. 1″	No. 2 Com. 1″	Shop 1″	No. 2 Shop 6/4	Shims	Total	Box 1″	Cull 2″	Box 6/4	No. 3 Shop 6/4	No. 3 Com. 1″	Plank 3″	4x4 & Lgr.	2x4 & wider No. 1 Dim.	Total	
	$\frac{100a_1'}{A'_1}$ +	$\frac{100b_1'}{A'_1}$ +	$\frac{100c_1'}{A'_1}$ +	$\frac{100d_1'}{A'_1}$	= Ap_1'	$\frac{100e_1'}{A'_1}$ +	$\frac{100f_1'}{A'_1}$ +	$\frac{100g_1'}{A'_1}$ +	$\frac{100h_1'}{A'_1}$ +	$\frac{100i_1'}{A'_1}$	= Bp_1'	$\frac{100j_1'}{A'_1}$ +	$\frac{100k_1'}{A'_1}$ +	$\frac{100l_1'}{A'_1}$ +	$\frac{100m_1'}{A'_1}$ +	$\frac{100n_1'}{A'_1}$ +	$\frac{100o_1'}{A'_1}$ +	$\frac{100p_1'}{A'_1}$ +	$\frac{100q_1'}{A'_1}$	= Cp_1'	A'_1
20	0.0	6.2	7.7	4.8	18.7	3.4	5.3	1.9	4.8	1.9	17.3	4.3	3.3	20.1	8.6	4.8	0.0	1.4	21.5	64.0	209
21	4.7	6.0	7.7	5.6	24.0	3.0	4.7	2.1	4.7	1.7	16.2	3.8	3.0	17.5	7.7	4.3	0.0	1.3	22.2	59.8	234
22	8.1	6.2	7.7	6.2	28.2	2.3	4.2	1.9	4.6	1.5	14.5	3.5	2.7	15.8	6.9	3.8	0.0	1.5	23.1	57.3	260
23	11.5	5.9	8.0	6.3	31.7	2.1	3.9	2.1	4.6	1.4	14.1	3.1	2.5	14.0	6.3	3.5	0.0	1.4	23.4	54.2	286
24	14.7	5.7	8.3	6.7	35.4	1.9	3.4	1.9	4.8	1.3	13.3	2.9	2.2	12.4	5.7	3.2	0.0	1.6	23.3	51.3	314
25	16.3	5.8	8.4	7.0	37.5	1.5	3.2	2.0	4.9	1.5	13.1	2.6	2.0	11.4	5.5	2.9	0.0	1.7	23.3	49.4	344
26	18.2	5.6	8.6	7.2	39.6	1.3	3.0	2.1	5.3	1.3	13.0	2.4	2.1	10.2	5.1	2.7	0.0	1.9	23.0	47.4	374
27	19.9	5.4	8.8	7.3	41.4	1.2	2.7	2.2	5.6	1.2	12.9	2.2	2.0	9.3	4.9	2.7	0.0	2.0	22.6	45.7	405
28	21.9	5.2	9.1	7.3	43.5	1.1	2.5	2.3	5.9	1.1	12.9	2.1	1.8	8.4	4.6	2.5	0.0	2.1	22.1	43.6	439
29	23.2	5.1	9.2	7.3	44.8	0.9	2.3	2.3	6.4	1.3	13.2	1.9	1.9	7.7	4.3	2.3	0.0	2.1	21.8	42.0	469
30	24.4	5.0	9.4	7.2	46.0	0.8	2.2	2.6	6.8	1.2	13.6	1.8	1.8	7.0	4.0	2.2	0.0	2.2	21.4	40.4	500
31	25.6	5.1	9.5	7.1	47.3	0.7	2.1	3.2	7.1	1.1	14.2	1.7	1.7	6.4	3.9	2.1	0.0	2.2	20.5	38.5	535
32	26.2	4.9	9.8	7.1	48.0	0.7	1.9	3.8	7.5	1.2	15.1	1.6	1.7	5.7	3.7	1.9	0.0	2.6	19.7	36.9	575
33	26.8	4.8	10.2	6.9	48.7	0.6	1.8	4.7	7.7	1.1	16.9	1.5	1.6	5.2	3.7	1.8	0.0	2.9	18.7	35.4	620
34	27.2	4.8	10.5	6.8	49.3	0.6	1.7	5.4	8.2	1.1	17.0	1.4	1.5	4.6	3.6	1.7	0.0	3.2	17.7	33.7	662
39	27.5	4.8	11.1	6.7	50.1	0.5	1.6	6.2	8.1	1.1	17.5	1.3	1.4	4.3	3.7	1.7	0.0	3.4	16.6	32.4	705
38	27.9	4.8	11.3	6.5	50.5	0.4	1.5	7.0	8.4	1.2	18.5	1.2	1.3	3.9	3.9	1.6	0.0	3.7	15.4	31.0	752
37	28.0	4.7	11.8	6.4	50.9	0.4	1.4	8.0	8.6	1.1	19.5	1.1	1.4	3.6	3.9	1.5	0.0	4.0	14.1	29.6	800
36	28.3	4.7	12.1	6.3	51.4	0.4	1.3	8.9	8.7	1.2	20.5	1.0	1.3	3.3	3.9	1.4	0.0	4.3	12.9	28.1	844
35	28.4	4.8	12.8	6.2	52.2	0.3	1.2	9.9	9.0	1.1	21.5	1.0	1.2	3.1	4.0	1.3	0.0	4.4	11.3	26.3	893
40	28.5	4.9	13.5	6.0	52.9	0.3	1.3	10.6	9.0	1.2	22.4	0.9	1.3	2.8	4.0	1.4	0.0	4.5	9.8	24.7	946
41	28.5	4.9	14.5	5.8	53.7	0.3	1.2	11.4	9.2	1.1	23.2	0.9	1.3	2.6	4.0	1.3	0.0	4.7	8.8	23.1	996
42	28.7	4.9	15.4	5.6	54.6	0.3	1.2	12.2	9.2	1.1	24.0	0.9	1.4	2.4	4.0	1.2	0.0	4.8	6.7	21.4	1052
43	28.7	4.9	16.5	5.4	55.5	0.3	1.2	12.8	9.3	1.1	24.7	0.8	1.6	2.1	4.0	1.2	0.0	5.0	5.1	19.8	1137
44	28.6	5.0	17.4	5.1	56.1	0.3	1.2	13.4	9.3	1.1	25.3	0.8	1.8	1.9	4.1	1.1	0.0	5.2	3.7	18.6	1182

TABLE 27.—*Value of grades sawed from 16' butt logs of immature trees of different diameters breasthigh, expressed in dollars and cents.*
(Values in this table obtained as indicated by .032*a'* + .030*b'* + etc. Curves Aval', Bval' and Cval' shown in Figs. 145, 146 and 147.)

Diameter breasthigh in inches	HIGH GRADES					INTERMEDIATE GRADES						LOW GRADES									Value per butt log
	C. & Bet. 6/4	Mldg. Stock	No. 1 Shop 6/4	D. Sel. & Bet. 1"	Total	No. 1 Com. 1"	No. 2 Com. 1"	Shop 1"	No. 2 Shop 6/4	Shims	Total	Box 1"	Cull 2"	Box 6/4	No. 3 Shop 6/4	No. 3 Com. 1"	Plank 3"	4x4 & Lgr.	2x4 & wider No. 1 Dim.	Total	
	.032a'+.030b'+.027c'+.025d'=Aval'					.022e'+.018f'+.018g'+.018h'+.007i'=Bval'						.009j'+.007k'+.011l'+.013m'+.015n'+.015o'+.015p'+.015q'=Cval'									B'
20	.10	.27	.11	.17	.65	.22	.20	.13	.13	.03	.70	.12	.03	.38	.23	.13	.10	.16	.75	1.90	3.25
21	.16	.30	.13	.25	.84	.22	.22	.13	.23	.03	.82	.11	.03	.37	.30	.13	.10	.16	.78	1.98	3.64
22	.23	.33	.16	.30	1.05	.22	.22	.13	.36	.03	.96	.10	.03	.37	.35	.13	.10	.16	.81	2.05	4.06
23	.38	.36	.22	.37	1.33	.22	.23	.13	.49	.03	1.10	.09	.03	.36	.36	.13	.10	.16	.85	2.08	4.51
24	.54	.39	.32	.45	1.70	.22	.23	.13	.58	.03	1.19	.09	.03	.36	.40	.13	.10	.18	.90	2.19	5.08
25	.77	.45	.43	.50	2.15	.22	.25	.14	.67	.03	1.31	.08	.03	.35	.42	.13	.10	.18	.93	2.22	5.68
26	.99	.48	.57	.55	2.59	.22	.27	.14	.74	.03	1.40	.08	.03	.35	.43	.13	.10	.18	.98	2.28	6.27
27	1.31	.54	.76	.62	3.23	.22	.27	.16	.83	.04	1.52	.07	.03	.34	.44	.15	.10	.18	1.02	2.33	7.08
28	1.60	.60	.95	.70	3.85	.22	.29	.16	.90	.04	1.61	.07	.03	.33	.44	.15	.10	.19	1.05	2.36	7.82
29	1.98	.63	1.11	.75	4.47	.22	.31	.18	.97	.05	1.73	.06	.03	.33	.43	.15	.10	.21	1.08	2.39	8.59
30	2.43	.66	1.35	.80	5.24	.22	.31	.18	1.01	.05	1.77	.06	.03	.33	.43	.15	.10	.24	1.14	2.48	9.49
31	2.82	.72	1.54	.87	5.96	.20	.32	.18	1.05	.05	1.80	.06	.04	.32	.42	.15	.10	.26	1.23	2.58	10.33
32	3.23	.78	1.76	.92	6.69	.20	.32	.20	1.07	.06	1.85	.05	.05	.32	.40	.15	.10	.27	1.27	2.61	11.15
33	3.65	.84	2.02	.97	7.48	.20	.34	.25	1.08	.06	1.93	.05	.06	.31	.39	.15	.10	.30	1.35	2.71	12.12
34	4.22	.90	2.27	1.02	8.41	.20	.36	.36	1.08	.06	2.06	.05	.06	.31	.36	.15	.10	.30	1.44	2.77	13.24
35	4.80	.96	2.51	1.05	9.32	.20	.36	.50	1.10	.06	2.22	.05	.07	.30	.34	.16	.10	.30	1.51	2.83	14.37
36	5.31	1.02	2.85	1.10	10.28	.18	.36	.68	1.10	.06	2.38	.05	.08	.30	.31	.16	.10	.30	1.57	2.87	15.53
37	5.83	1.08	3.05	1.12	11.08	.18	.38	.92	1.10	.06	2.64	.05	.09	.29	.30	.16	.10	.28	1.62	2.89	16.61
38	6.33	1.17	3.26	1.18	11.94	.18	.38	1.21	1.10	.07	2.94	.05	.11	.27	.28	.16	.09	.27	1.61	2.84	17.72
39	6.95	1.23	3.56	1.23	12.97	.15	.38	1.53	1.08	.08	3.22	.05	.13	.27	.26	.16	.09	.24	1.56	2.76	18.95
40	7.55	1.29	3.84	1.25	13.93	.15	.40	1.86	1.08	.10	3.59	.05	.14	.26	.25	.16	.09	.21	1.52	2.68	20.20
41	8.00	1.38	4.13	1.27	14.78	.15	.40	2.27	1.08	.12	4.02	.05	.16	.26	.23	.16	.09	.18	1.46	2.59	21.39
42	8.51	1.50	4.40	1.30	15.71	.15	.42	2.66	1.06	.15	4.44	.05	.18	.25	.21	.16	.09	.14	1.36	2.44	22.59

TABLE 28.—*Value of grades sawed from 16′ butt logs of mature trees of different diameters breasthigh, expressed in dollars and cents.* (Values in this table obtained as indicated by $.032a_1' + .030b_1'$ + etc. Curves Aval$_1'$, Bval$_1'$ and Cval$_1'$ shown in Figs. 148, 149 and 150.)

Diameter breasthigh in inches	HIGH GRADES					INTERMEDIATE GRADES						LOW GRADES									Value per butt log
	C. & Bet. 6/4	Mldg. Stock	No. 1 Shop 6/4	D. Sel. & Bet. 1″	Total	No. 1 Com. 1″	No. 2 Com. 1″	Shop 1″	No. 2 Shop 6/4	Shims	Total	Box 1″	Cull 2″	Box 6/4	No. 3 Shop 6/4	No. 3 Com. 1″	Plank 3″	4x4 & Lgr.	2x4 & wider No. 1 Dim.	Total	
	$.032a_1'+.030b_1'+.027c_1'+.025d_1'=\text{Aval}_1'$					$.022e_1'+.018f_1'+.018g_1'+.018h_1'+.007l_1'=\text{Bval}_1'$						$.009j_1'+.007k_1'+.011l_1'+.013m_1'+.015n_1'+.015o_1'+.015p_1'+.015q_1'=\text{Cval}_1'$									B_1'
20	.00	.39	.43	.25	1.07	.15	.20	.07	.18	.03	.63	.08	.05	.46	.23	.15	.00	.05	.68	1.70	3.40
21	.35	.42	.49	.33	1.59	.15	.20	.09	.20	.03	.67	.08	.05	.45	.23	.15	.00	.05	.78	1.79	4.05
22	.67	.48	.54	.40	2.09	.13	.20	.09	.22	.03	.67	.08	.05	.45	.23	.15	.00	.06	.90	1.92	4.68
23	1.06	.51	.62	.45	2.64	.13	.20	.11	.23	.03	.70	.08	.05	.44	.23	.15	.00	.06	1.01	2.02	5.36
24	1.47	.54	.70	.52	3.23	.13	.20	.11	.27	.03	.74	.08	.05	.43	.23	.15	.00	.07	1.10	2.11	6.08
25	1.80	.60	.78	.60	3.78	.11	.20	.13	.31	.04	.79	.08	.05	.43	.25	.15	.00	.09	1.20	2.25	6.82
26	2.18	.63	.87	.68	4.36	.11	.20	.14	.36	.04	.85	.08	.06	.42	.25	.15	.00	.11	1.29	2.36	7.57
27	2.59	.66	.97	.75	4.97	.11	.20	.16	.42	.04	.93	.08	.06	.42	.26	.17	.00	.12	1.37	2.48	8.38
28	3.04	.69	1.08	.80	5.61	.11	.20	.18	.47	.04	1.00	.08	.06	.41	.26	.17	.00	.14	1.46	2.58	9.19
29	3.49	.72	1.16	.85	6.22	.09	.20	.20	.54	.04	1.07	.08	.06	.40	.26	.17	.00	.15	1.58	2.65	9.94
30	3.94	.75	1.27	.90	6.86	.09	.20	.23	.61	.04	1.17	.08	.06	.39	.26	.17	.00	.17	1.60	2.78	10.76
31	4.38	.81	1.38	.95	7.52	.09	.20	.31	.69	.04	1.33	.08	.06	.37	.27	.17	.00	.18	1.65	2.78	11.63
32	4.83	.84	1.51	1.02	8.20	.09	.20	.40	.78	.05	1.52	.08	.07	.36	.27	.17	.00	.22	1.70	2.87	12.59
33	5.32	.90	1.70	1.08	9.00	.09	.20	.52	.87	.05	1.73	.08	.07	.35	.30	.17	.00	.27	1.74	2.98	13.71
34	5.76	.96	1.89	1.13	9.74	.09	.20	.65	.97	.05	1.96	.08	.07	.34	.31	.17	.00	.32	1.76	3.06	14.75
35	6.24	1.02	2.11	1.18	10.55	.07	.20	.79	1.03	.06	2.15	.08	.07	.33	.34	.18	.00	.36	1.76	3.12	15.82
36	6.72	1.08	2.30	1.22	11.32	.07	.20	.96	1.14	.06	2.43	.08	.07	.32	.38	.18	.00	.42	1.74	3.19	16.94
37	7.17	1.14	2.54	1.27	12.12	.07	.20	1.15	1.24	.06	2.72	.08	.08	.32	.40	.18	.00	.48	1.70	3.24	18.08
38	7.65	1.20	2.76	1.33	12.94	.07	.20	1.35	1.32	.07	3.01	.08	.08	.31	.43	.18	.00	.54	1.64	3.26	19.21
39	8.10	1.29	3.08	1.38	13.85	.07	.20	1.58	1.44	.07	3.36	.08	.08	.31	.47	.18	.00	.58	1.52	3.22	20.43
40	8.62	1.38	3.46	1.43	14.89	.07	.22	1.80	1.53	.08	3.70	.08	.08	.30	.50	.20	.00	.65	1.40	3.21	21.80
41	9.10	1.47	3.89	1.45	15.91	.07	.22	2.04	1.64	.08	4.05	.08	.09	.29	.52	.20	.00	.70	1.25	3.13	23.09
42	9.64	1.56	4.37	1.48	17.05	.07	.23	2.30	1.75	.08	4.43	.08	.11	.28	.55	.20	.00	.77	1.05	3.04	24.52
43	10.25	1.65	4.97	1.50	18.37	.07	.25	2.58	1.87	.08	4.85	.08	.13	.26	.59	.20	.00	.84	.86	2.96	26.18
44	10.83	1.77	5.57	1.50	19.67	.07	.25	2.86	1.98	.09	5.25	.08	.15	.25	.63	.20	.00	.98	.66	2.90	27 82

AVERAGE VALUES FOR TOP LOGS.

TABLE 29.—*Volume in board feet of each grade sawed out at mill from top logs of immature western yellow pine trees of different diameters breasthigh.*

(Values read from curves shown on left-hand pages Nos. 106 to 116, inclusive.)

Diameter breasthigh in inches	HIGH GRADES					INTERMEDIATE GRADES						LOW GRADES									Total sawed out., all grades
	C. & Bet. 6/4	Mldg. Stock	No. 1 Shop 6/4	D. Sel. & Bet. 1"	Total	No. 1 Com. 1"	No. 2 Com. 1"	Shop 1"	No. 2 Shop 6/4	Shims	Total	Box 1"	Cull 2"	Box 6/4	No. 3 Shop 6/4	No. 3 Com. 1"	Plank 3"	4x4 & Lgr.	2x4 & wider No. 1 Dim.	Total	
	a" +	b" +	c" +	d"	= Av"	e" +	f" +	g" +	h" +	i"	= Bv"	j" +	k" +	l" +	m" +	n" +	o" +	p" +	q"	= Cv"	A"
20	0	0	0	0	0	0	4	0	0	0	4	11	0	4	0	4	0	7	16	42	46
21	0	0	0	0	0	0	4	0	0	0	4	11	0	4	0	4	0	7	16	42	46
22	0	0	0	0	0	0	4	0	0	0	4	12	0	4	0	4	0	7	17	44	48
23	0	0	0	0	0	0	4	0	0	0	4	12	0	4	0	4	0	8	17	45	49
24	0	0	0	0	0	0	4	0	0	0	4	12	0	4	0	4	0	8	18	46	50
25	0	0	0	0	0	0	4	0	0	0	4	13	0	5	0	4	0	8	19	49	53
26	0	0	0	0	0	0	4	0	0	0	4	13	0	5	0	4	0	8	20	50	54
27	0	0	0	0	0	0	4	0	0	0	4	13	0	5	0	4	0	9	20	51	55
28	0	0	0	0	0	0	4	0	0	0	4	13	0	6	0	4	0	9	21	53	57
29	0	0	0	0	0	0	4	0	0	0	4	14	0	6	0	4	0	9	22	55	59
30	0	0	0	0	0	0	4	0	0	0	4	14	0	7	0	4	0	9	22	56	60
31	0	0	0	0	0	0	4	0	0	0	4	14	0	7	0	4	0	10	23	58	62
32	0	0	0	0	0	0	4	0	0	0	4	14	0	7	0	4	0	10	24	59	63
33	0	0	0	0	0	0	3	0	0	0	3	15	0	8	0	4	0	10	25	62	65
34	0	0	0	0	0	0	3	0	0	0	3	15	0	9	0	4	0	10	26	64	67
35	0	0	0	0	0	0	3	0	0	0	3	15	0	10	0	4	0	10	27	66	69
36	0	0	0	0	0	0	3	0	0	0	3	16	0	12	0	4	0	11	27	70	73
37	0	0	0	0	0	0	3	0	0	0	3	17	0	14	0	3	0	11	28	73	76
38	0	0	0	0	0	0	3	0	0	0	3	18	0	16	0	3	0	11	28	76	79
39	0	0	0	0	0	0	3	0	0	0	3	19	0	18	0	3	0	11	29	80	83
40	0	0	0	0	0	0	3	0	0	0	3	20	0	20	0	3	0	11	30	84	87
41	0	0	0	0	0	0	3	0	0	0	3	22	0	23	0	3	0	12	31	91	94
42	0	0	0	0	0	0	3	0	0	0	3	24	0	27	0	3	0	12	32	98	101

TABLE 30.—*Volume in board feet of each grade sawed out at mill from top logs of mature western yellow pine trees of different diameters breasthigh.*

(Values read from curves shown on right-hand pages Nos. 107 to 117, inclusive.)

Diameter breasthigh in inches	HIGH GRADES					INTERMEDIATE GRADES						LOW GRADES									Total sawed out, all grades
	C. & Bet. 6/4	Mldg. Stock	No. 1 Shop 6/4	D. Sel. & Bet. 1"	Total	No. 1 Com. 1"	No. 2 Com. 1"	Shop 1"	No. 2 Shop 6/4	Shims	Total	Box 1"	Cull 2"	Box 6/4	No. 3 Shop 6/4	No. 3 Com. 1"	Plank 3"	4x4 & Lgr.	2x4 & wider No. 1 Dim.	Total	
	a_1'' +	b_1'' +	c_1'' +	d_1'' =	Av_1''	e_1'' +	f_1'' +	g_1'' +	h_1'' +	i_1'' =	Bv_1''	j_1'' +	k_1'' +	l_1'' +	m_1'' +	n_1'' +	o_1'' +	p_1'' +	q_1'' =	Ov_1''	A_1''
20	0	0	0	0	0	0	4	0	0	0	4	12	0	5	2	5	0	11	32	67	71
21	0	0	0	0	0	0	4	0	0	0	4	12	0	6	2	5	0	11	32	68	72
22	0	0	0	0	0	0	4	0	0	0	4	13	0	6	2	5	0	11	33	70	74
23	0	0	0	0	0	0	4	0	0	0	4	13	0	7	3	5	0	11	33	72	76
24	0	0	0	0	0	0	4	0	0	0	4	14	0	7	3	5	0	11	33	73	77
25	0	0	0	0	0	0	4	0	0	0	4	14	0	8	3	5	0	11	34	75	79
26	0	0	0	0	0	0	4	0	0	0	4	15	0	8	3	5	0	11	34	76	80
27	0	0	0	0	0	0	4	0	0	0	4	15	0	9	4	5	0	11	34	78	82
28	0	0	0	0	0	0	4	0	0	0	4	16	0	9	4	5	0	11	35	80	84
29	0	0	0	0	0	0	4	0	0	0	4	17	0	10	4	5	0	11	35	82	86
30	0	0	0	0	0	0	4	0	2	0	6	18	0	10	5	5	0	11	35	84	90
31	0	0	0	0	0	0	4	0	2	0	6	18	0	11	5	5	0	11	36	86	92
32	0	0	0	0	0	0	4	0	2	0	6	19	0	12	5	5	0	11	36	88	94
33	0	0	0	0	0	0	3	0	2	0	5	20	0	13	5	5	0	11	36	90	95
34	0	0	0	0	0	0	3	0	3	0	6	21	0	14	6	5	0	11	36	93	99
35	0	0	0	0	0	0	3	0	3	0	6	22	0	15	6	5	0	12	37	97	103
36	0	0	0	0	0	0	3	0	3	0	6	24	0	16	6	5	0	12	37	100	106
37	0	0	0	0	0	0	3	0	4	0	7	26	0	18	6	5	0	12	37	104	111
38	0	0	0	0	0	0	3	0	5	0	8	28	0	20	7	5	0	12	37	109	117
39	0	0	0	0	0	0	3	0	6	0	9	30	0	23	7	5	0	12	38	115	124
40	0	0	0	0	0	0	3	0	7	0	10	32	0	25	7	5	0	12	38	119	129
41	0	0	0	0	0	0	3	0	8	0	11	35	0	28	7	5	0	12	38	125	136
42	0	0	0	0	0	0	3	0	9	0	12	38	0	31	8	5	0	12	38	132	144
43	0	0	0	0	0	0	3	0	9	0	12	41	0	35	8	5	0	12	39	140	152
44	0	0	0	0	0	0	3	0	10	0	13	45	0	39	8	5	0	12	39	148	161

TABLE 31.—*Grades sawed from top logs of immature trees of different diameters breasthigh, expressed in per cent of total sawed out.*

(Values in this table obtained as indicated by $\frac{100a''}{A''}+\frac{100b''}{A''}+$ etc.)

Diameter breasthigh in inches	HIGH GRADES					INTERMEDIATE GRADES						LOW GRADES									Total sawed out, all grades
	C. & Bet. 6/4	Mldg. Stock	No. 1 Shop 6/4	D. Sel. & Bet. 1"	Total	No. 1 Com. 1"	No. 2 Com. 1"	Shop 1"	No. 2 Shop 6/4	Shims	Total	Box 1"	Cull 2"	Box 6/4	No. 3 Shop 6/4	No. 3 Com. 1"	Plank 3"	4x4 & Lgr.	2x4 & wider No. 1 Dim.	Total	
	$\frac{100a''}{A''}+$	$\frac{100b''}{A''}+$	$\frac{100c''}{A''}+$	$\frac{100d''}{A''}=$	Ap"	$\frac{100e''}{A''}+$	$\frac{100f''}{A''}+$	$\frac{100g''}{A''}+$	$\frac{100h''}{A''}+$	$\frac{100i''}{A''}=$	Bp"	$\frac{100j''}{A''}+$	$\frac{100k''}{A''}+$	$\frac{100l''}{A''}+$	$\frac{100m''}{A''}+$	$\frac{100n''}{A''}+$	$\frac{100o''}{A''}+$	$\frac{100p''}{A''}+$	$\frac{100q''}{A''}=$	Cp"	A"
20	0.0	0.0	0.0	0.0	0.0	0.0	8.7	0.0	0.0	0.0	8.7	23.9	0.0	8.7	0.0	8.7	0.0	15.2	34.8	91.3	46
21	0.0	0.0	0.0	0.0	0.0	0.0	8.7	0.0	0.0	0.0	8.7	23.9	0.0	8.7	0.0	8.7	0.0	15.2	34.8	91.3	46
22	0.0	0.0	0.0	0.0	0.0	0.0	8.3	0.0	0.0	0.0	8.3	25.0	0.0	8.3	0.0	8.3	0.0	14.6	35.5	91.7	48
23	0.0	0.0	0.0	0.0	0.0	0.0	8.2	0.0	0.0	0.0	8.2	24.5	0.0	8.1	0.0	8.2	0.0	16.3	34.7	91.8	49
24	0.0	0.0	0.0	0.0	0.0	0.0	8.0	0.0	0.0	0.0	8.0	24.0	0.0	8.0	0.0	8.0	0.0	16.0	36.0	92.0	50
25	0.0	0.0	0.0	0.0	0.0	0.0	7.6	0.0	0.0	0.0	7.6	24.5	0.0	9.4	0.0	7.6	0.0	15.1	35.8	92.4	53
26	0.0	0.	0.0	0.0	0.0	0.0	7.4	0.0	0.0	0.0	7.4	24.1	0.0	9.3	0.0	7.4	0.0	14.8	37.0	92.6	54
27	0.0	0.0	0.0	0.0	0.0	0.0	7.3	0.0	0.0	0.0	7.3	23.5	0.0	9.1	0.0	7.3	0.0	16.4	36.4	92.7	55
28	0.0	0.0	0.0	0.0	0.0	0.0	7.0	0.0	0.0	0.0	7.0	22.8	0.0	10.6	0.0	7.0	0.0	15.8	36.8	93.0	57
29	0.0	0.0	0.0	0.0	0.0	0.0	6.8	0.0	0.0	0.0	6.8	23.6	0.0	10.2	0.0	6.8	0.0	15.3	37.3	93.2	59
30	0.0	0.0	0.0	0.0	0.0	0.0	6.7	0.0	0.0	0.0	6.7	23.2	0.0	11.7	0.0	6.7	0.0	15.0	36.7	93.3	60
31	0.0	0.0	0.0	0.0	0.0	0.0	6.5	0.0	0.0	0.0	6.5	22.6	0.0	11.3	0.0	6.4	0.0	16.1	37.1	93.5	62
32	0.0	0.0	0.0	0.0	0.0	0.0	6.4	0.0	0.0	0.0	6.4	22.2	0.0	11.1	0.0	6.4	0.0	15.8	38.1	93.6	63
33	0.0	0.0	0.0	0.0	0.0	0.0	4.6	0.0	0.0	0.0	4.6	23.1	0.0	12.3	0.0	6.1	0.0	15.4	38.5	95.4	65
34	0.0	0.0	0.0	0.0	0.0	0.0	4.5	0.0	0.0	0.0	4.5	22.3	0.0	13.5	0.0	6.0	0.0	14.9	38.8	95.5	67
35	0.0	0.0	0.0	0.0	0.0	0.0	4.4	0.0	0.0	0.0	4.4	21.7	0.0	14.5	0.0	5.8	0.0	14.5	39.1	95.6	69
36	0.0	0.0	0.0	0.0	0.0	0.0	4.1	0.0	0.0	0.0	4.1	21.9	0.0	16.4	0.0	5.5	0.0	15.1	37.0	95.9	73
37	0.0	0.0	0.0	0.0	0.0	0.0	4.0	0.0	0.0	0.0	4.0	22.4	0.0	18.4	0.0	3.9	0.0	14.5	36.8	96.0	76
38	0.0	0.0	0.0	0.0	0.0	0.0	3.8	0.0	0.0	0.0	3.8	22.8	0.0	20.2	0.0	3.9	0.0	13.9	35.4	96.2	79
39	0.0	0.0	0.0	0.0	0.0	0.0	3.6	0.0	0.0	0.0	3.6	22.9	0.0	21.7	0.0	3.6	0.0	13.2	35.0	96.4	83
40	0.0	0.0	0.0	0.0	0.0	0.0	3.5	0.0	0.0	0.0	3.5	23.0	0.0	23.0	0.0	3.4	0.0	12.6	34.5	96.5	87
41	0.0	0.0	0.0	0.0	0.0	0.0	3.2	0.0	0.0	0.0	3.2	23.4	0.0	24.4	0.0	3.2	0.0	12.8	33.0	96.8	94
42	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	3.0	23.8	0.0	26.7	0.0	3.0	0.0	11.9	31.6	97.0	101

TABLE 32.—*Grades sawed from top logs of mature trees of different diameters breasthigh, expressed in per cent of total sawed out.*

(Values in this table obtained as indicated by $\frac{100a_1''}{A_1''} + \frac{100b_1''}{A_1''} + \text{etc.}$)

Diameter breasthigh in inches	HIGH GRADES					INTERMEDIATE GRADES						LOW GRADES									Total sawed out, all grades
	C. & Bet. 6/4	Mldg. Stock	No. 1 Shop 6/4	D. Sel. & Bet. 1"	Total	No. 1 Com. 1"	No. 2 Com. 1"	Shop 1"	No. 2 Shop 6/4	Shims	Total	Box 1"	Cull 2"	Box 6/4	No. 3 Shop 6/4	No. 3 Com. 1"	Plank 3"	4x4 & Lgr.	2x4 & wider No. 1 Dim.	Total	
	$\frac{100a_1''}{A_1''}+$	$\frac{100b_1''}{A_1''}+$	$\frac{100c_1''}{A_1''}+$	$\frac{100d_1''}{A_1''}$	$=Ap_1''$	$\frac{100e_1''}{A_1''}+$	$\frac{100f_1''}{A_1''}+$	$\frac{100g_1''}{A_1''}+$	$\frac{100h_1''}{A_1''}+$	$\frac{100i_1''}{A_1''}$	$=Bp_1''$	$\frac{100j_1''}{A_1''}+$	$\frac{100k_1''}{A_1''}+$	$\frac{100l_1''}{A_1''}+$	$\frac{100m_1''}{A_1''}+$	$\frac{100n_1''}{A_1''}+$	$\frac{100o_1''}{A_1''}+$	$\frac{100p_1''}{A_1''}+$	$\frac{100q_1''}{A_1''}$	$=Cp_1''$	A_1''
20	0.0	0.0	0.0	0.0	0.0	0.0	5.6	0.0	0.0	0.0	5.6	16.9	0.0	7.0	2.8	7.1	0.0	15.5	45.1	94.4	71
21	0.0	0.0	0.0	0.0	0.0	0.0	5.6	0.0	0.0	0.0	5.6	16.6	0.0	8.3	2.8	7.0	0.0	15.3	44.4	94.4	72
22	0.0	0.0	0.0	0.0	0.0	0.0	5.4	0.0	0.0	0.0	5.4	17.6	0.0	8.1	2.7	6.8	0.0	14.8	44.6	94.6	74
23	0.0	0.0	0.0	0.0	0.0	0.0	5.3	0.0	0.0	0.0	5.3	17.1	0.0	9.2	3.9	6.6	0.0	14.5	43.4	94.7	76
24	0.0	0.0	0.0	0.0	0.0	0.0	5.2	0.0	0.0	0.0	5.2	18.2	0.0	9.1	3.9	6.5	0.0	14.3	42.8	94.8	77
25	0.0	0.0	0.0	0.0	0.0	0.0	5.1	0.0	0.0	0.0	5.1	17.7	0.0	10.1	3.8	6.4	0.0	13.9	43.0	94.9	79
26	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0	0.0	0.0	5.0	18.7	0.0	10.0	3.8	6.3	0.0	13.7	42.5	95.0	80
27	0.0	0.0	0.0	0.0	0.0	0.0	4.9	0.0	0.0	0.0	4.9	18.3	0.0	11.0	4.9	6.1	0.0	13.4	41.4	95.1	82
28	0.0	0.0	0.0	0.0	0.0	0.0	4.8	0.0	0.0	0.0	4.8	19.0	0.0	10.7	4.8	5.9	0.0	13.1	41.7	95.2	84
29	0.0	0.0	0.0	0.0	0.0	0.0	4.7	0.0	0.0	0.0	4.7	19.7	0.0	11.6	4.7	5.8	0.0	12.8	40.7	95.3	86
30	0.0	0.0	0.0	0.0	0.0	0.0	4.4	0.0	2.2	0.0	6.6	20.0	0.0	11.1	5.6	5.6	0.0	12.2	38.9	93.4	90
31	0.0	0.0	0.0	0.0	0.0	0.0	4.3	0.0	2.1	0.0	6.4	19.6	0.0	12.0	5.4	5.4	0.0	12.0	39.2	93.7	92
32	0.0	0.0	0.0	0.0	0.0	0.0	4.3	0.0	2.1	0.0	6.4	20.2	0.0	12.8	5.3	5.3	0.0	11.7	38.3	93.6	94
33	0.0	0.0	0.0	0.0	0.0	0.0	3.2	0.0	2.1	0.0	5.3	21.0	0.0	13.6	5.3	5.3	0.0	11.6	37.9	94.7	96
34	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	3.0	0.0	6.0	21.2	0.0	14.1	6.1	5.1	0.0	11.1	36.4	94.0	99
35	0.0	0.0	0.0	0.0	0.0	0.0	2.9	0.0	2.9	0.0	5.8	21.4	0.0	14.6	5.8	4.9	0.0	11.6	35.9	94.2	103
36	0.0	0.0	0.0	0.0	0.0	0.0	2.8	0.0	2.8	0.0	5.6	22.6	0.0	15.2	5.7	4.7	0.0	11.3	34.9	94.3	106
37	0.0	0.0	0.0	0.0	0.0	0.0	2.7	0.0	3.6	0.0	6.3	23.4	0.0	16.2	5.5	4.5	0.0	10.8	33.3	93.7	111
38	0.0	0.0	0.0	0.0	0.0	0.0	2.6	0.0	4.3	0.0	6.9	23.9	0.0	17.1	5.9	4.3	0.0	10.3	31.6	93.1	117
39	0.0	0.0	0.0	0.0	0.0	0.0	2.4	0.0	4.8	0.0	7.2	24.2	0.0	18.6	5.7	4.0	0.0	9.7	30.6	92.8	124
40	0.0	0.0	0.0	0.0	0.0	0.0	2.3	0.0	5.4	0.0	7.7	24.8	0.0	19.5	5.4	3.9	0.0	9.3	29.4	92.3	129
41	0.0	0.0	0.0	0.0	0.0	0.0	2.2	0.0	5.9	0.0	8.1	25.7	0.0	20.6	5.2	3.7	0.0	8.8	27.9	91.9	136
42	0.0	0.0	0.0	0.0	0.0	0.0	2.1	0.0	6.2	0.0	8.3	26.4	0.0	21.5	5.6	3.5	0.0	8.3	26.4	91.7	144
43	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	5.9	0.0	7.9	27.0	0.0	23.0	5.3	3.3	0.0	7.9	25.6	92.1	152
44	0.0	0.0	0.0	0.0	0.0	0.0	1.9	0.0	6.2	0.0	8.1	27.9	0.0	24.2	5.0	3.1	0.0	7.5	24.2	91.9	161

TABLE 33.—*Value of grades sawed from top logs of immature trees of different diameters breasthigh, expressed in dollars and cents.* (Values in this table obtained as indicated by .032a″ + .030b″ + etc. Curves Bval″ and Cval″ shown in Figs. 189 and 190.)

Diameter breasthigh in inches	HIGH GRADES					INTERMEDIATE GRADES						LOW GRADES									Value per top log
	C. & Bet. 6/4	Mldg. Stock	No. 1 Shop 6/4	D. Sel. & Bet. 1″	Total	No. 1 Com. 1″	No. 2 Com. 1″	Shop 1″	No. 2 Shop 6/4	Shims	Total	Box 1″	Cull 2″	Box 6/4	No. 3 Shop 6/4	No. 3 Com. 1″	Plank 3″	4x4 & Lgr.	2x4 & wider No. 1 Dim.	Total	
	.032a″ +	.025b″ +	.027c″ +	.025d″ =	Aval″	.022e″ +	.018f″ +	.018g″ +	.018h″ +	.007i″ =	Bval″	.009j″ +	.007k″ +	.011l″ +	.013m″ +	.015n″ +	.015o″ +	.015p″ +	.015q″ =	Cval″	B″
20	.00	.00	.00	.00	.00	.00	.07	.00	.00	.00	.07	.10	.00	.04	.00	.06	.00	.10	.24	.54	.61
21	.00	.00	.00	.00	.00	.00	.07	.00	.00	.00	.07	.10	.00	.04	.00	.06	.00	.10	.24	.54	.61
22	.00	.00	.00	.00	.00	.00	.07	.00	.00	.00	.07	.11	.00	.04	.00	.06	.00	.10	.26	.57	.64
23	.00	.00	.00	.00	.00	.00	.07	.00	.00	.00	.07	.11	.00	.04	.00	.06	.00	.12	.26	.59	.66
24	.00	.00	.00	.00	.00	.00	.07	.00	.00	.00	.07	.11	.00	.04	.00	.06	.00	.12	.27	.60	.67
25	.00	.00	.00	.00	.00	.00	.07	.00	.00	.00	.07	.12	.00	.05	.00	.06	.00	.12	.29	.64	.71
26	.00	.00	.00	.00	.00	.00	.07	.00	.00	.00	.07	.12	.00	.05	.00	.06	.00	.12	.30	.65	.72
27	.00	.00	.00	.00	.00	.00	.07	.00	.00	.00	.07	.12	.00	.05	.00	.06	.00	.14	.30	.67	.74
28	.00	.00	.00	.00	.00	.00	.07	.00	.00	.00	.07	.12	.00	.07	.00	.06	.00	.14	.32	.71	.78
29	.00	.00	.00	.00	.00	.00	.07	.00	.00	.00	.07	.13	.00	.07	.00	.06	.00	.14	.33	.73	.80
30	.00	.00	.00	.00	.00	.00	.07	.00	.00	.00	.07	.13	.00	.08	.00	.06	.00	.14	.33	.74	.81
31	.00	.00	.00	.00	.00	.00	.07	.00	.00	.00	.07	.13	.00	.08	.00	.06	.00	.15	.35	.77	.84
32	.00	.00	.00	.00	.00	.00	.07	.00	.00	.00	.07	.13	.00	.08	.00	.06	.00	.15	.36	.78	.85
33	.00	.00	.00	.00	.00	.00	.05	.00	.00	.00	.05	.14	.00	.09	.00	.06	.00	.15	.38	.82	.87
34	.00	.00	.00	.00	.00	.00	.05	.00	.00	.00	.05	.14	.00	.10	.00	.06	.00	.15	.39	.84	.89
35	.00	.00	.00	.00	.00	.00	.05	.00	.00	.00	.05	.14	.00	.11	.00	.06	.00	.15	.41	.87	.92
36	.00	.00	.00	.00	.00	.00	.05	.00	.00	.00	.05	.14	.00	.13	.00	.06	.00	.17	.41	.91	.96
37	.00	.00	.00	.00	.00	.00	.05	.00	.00	.00	.05	.15	.00	.15	.00	.04	.00	.17	.42	.93	.98
38	.00	.00	.00	.00	.00	.00	.05	.00	.00	.00	.05	.16	.00	.18	.00	.04	.00	.17	.42	.97	1.02
39	.00	.00	.00	.00	.00	.00	.05	.00	.00	.00	.05	.17	.00	.20	.00	.04	.00	.17	.44	1.02	1.07
40	.00	.00	.00	.00	.00	.00	.05	.00	.00	.00	.05	.18	.00	.22	.00	.04	.00	.17	.45	1.06	1.11
41	.00	.00	.00	.00	.00	.00	.05	.00	.00	.00	.05	.20	.00	.25	.00	.04	.00	.18	.47	1.14	1.19
42	.00	.00	.00	.00	.00	.00	.05	.00	.00	.00	.05	.22	.00	.30	.00	.04	.00	.18	.48	1.22	1.27

TABLE 34.—*Value of grades sawed from top logs of mature trees of different diameters breasthigh, expressed in dollars and cents.* (Values in this table obtained as indicated by $.032a_1'' + .030b_1'' +$ etc. Curves Bval_1'' and Cval_1'' shown in Figs. 191 and 192.)

Diameter breasthigh in inches	HIGH GRADES					INTERMEDIATE GRADES						LOW GRADES									Value per top log
	C. & Bet. 6/4	Mldg. Stock	No. 1 Shop 6/4	D. Sel. & Bet. 1"	Total	No. 1 Com. 1"	No. 2 Com. 1"	Shop 1"	No. 2 Shop 6/4	Shims	Total	Box 1"	Cull 2"	Box 6/4	No. 3 Shop 6/4	No. 3 Com. 1"	Plank 3"	4x4 & Lgr.	2x4 & wider No. 1 Dim.	Total	
	$.032a_1''+$	$.030b_1''+$	$.027c_1''+$	$.025d_1''=$	Aval_1''	$.022e_1''+$	$.018f_1''+$	$.018g_1''+$	$.018h_1''+$	$.007i_1''=$	Bval_1''	$.009j_1''+$	$.007k_1''+$	$.011l_1''+$	$.013m_1''+$	$.015n_1''+$	$.015o_1''+$	$.015p_1''+$	$.015q_1''=$	Cval_1''	B_1''
20	.00	.00	.00	.00	.00	.00	.07	.00	.00	.00	.07	.11	.00	.05	.03	.07	.00	.16	.48	.90	.97
21	.00	.00	.00	.00	.00	.00	.07	.00	.00	.00	.07	.11	.00	.07	.03	.07	.00	.16	.48	.92	.99
22	.00	.00	.00	.00	.00	.00	.07	.00	.00	.00	.07	.12	.00	.07	.03	.07	.00	.16	.50	.95	1.02
23	.00	.00	.00	.00	.00	.00	.07	.00	.00	.00	.07	.12	.00	.08	.04	.07	.00	.16	.50	.97	1.04
24	.00	.00	.00	.00	.00	.00	.07	.00	.00	.00	.07	.12	.00	.08	.04	.07	.00	.16	.50	.97	1.04
25	.00	.00	.00	.00	.00	.00	.07	.00	.00	.00	.07	.12	.00	.09	.04	.07	.00	.16	.51	.99	1.06
26	.00	.00	.00	.00	.00	.00	.07	.00	.00	.00	.07	.13	.00	.09	.04	.07	.00	.16	.51	1.00	1.07
27	.00	.00	.00	.00	.00	.00	.07	.00	.00	.00	.07	.13	.00	.10	.05	.07	.00	.16	.51	1.02	1.09
28	.00	.00	.00	.00	.00	.00	.07	.00	.00	.00	.07	.14	.00	.10	.05	.07	.00	.16	.52	1.04	1.11
29	.00	.00	.00	.00	.00	.00	.07	.00	.00	.00	.07	.15	.00	.11	.05	.07	.00	.16	.52	1.06	1.13
30	.00	.00	.00	.00	.00	.00	.07	.00	.04	.00	.11	.16	.00	.11	.06	.07	.00	.16	.52	1.08	1.19
31	.00	.00	.00	.00	.00	.00	.07	.00	.04	.00	.11	.16	.00	.12	.06	.07	.00	.16	.54	1.11	1.22
32	.00	.00	.00	.00	.00	.00	.07	.00	.04	.00	.11	.17	.00	.13	.06	.07	.00	.16	.54	1.13	1.24
33	.00	.00	.00	.00	.00	.00	.05	.00	.04	.00	.09	.18	.00	.14	.06	.07	.00	.16	.54	1.15	1.24
34	.00	.00	.00	.00	.00	.00	.05	.00	.05	.00	.10	.19	.00	.15	.08	.07	.00	.16	.54	1.19	1.29
35	.00	.00	.00	.00	.00	.00	.05	.00	.05	.00	.10	.20	.00	.16	.08	.07	.00	.18	.55	1.24	1.34
36	.00	.00	.00	.00	.00	.00	.05	.00	.05	.00	.10	.21	.00	.18	.08	.07	.00	.18	.55	1.27	1.37
37	.00	.00	.00	.00	.00	.00	.05	.00	.07	.00	.12	.23	.00	.20	.08	.07	.00	.18	.55	1.31	1.43
38	.00	.00	.00	.00	.00	.00	.05	.00	.09	.00	.14	.25	.00	.22	.09	.07	.00	.18	.55	1.36	1.50
39	.00	.00	.00	.00	.00	.00	.05	.00	.11	.00	.16	.27	.00	.25	.09	.07	.00	.18	.57	1.43	1.59
40	.00	.00	.00	.00	.00	.00	.05	.00	.13	.00	.18	.29	.00	.27	.09	.07	.00	.18	.57	1.47	1.65
41	.00	.00	.00	.00	.00	.00	.05	.00	.14	.00	.19	.31	.00	.31	.09	.07	.00	.18	.57	1.53	1.72
42	.00	.00	.00	.00	.00	.00	.05	.00	.16	.00	.21	.34	.00	.34	.10	.07	.00	.18	.57	1.60	1.81
43	.00	.00	.00	.00	.00	.00	.05	.00	.16	.00	.21	.37	.00	.39	.10	.07	.00	.18	.59	1.70	1.91
44	.00	.00	.00	.00	.00	.00	.05	.00	.18	.00	.23	.40	.00	.43	.10	.07	.00	.18	.59	1.77	2.00

AVERAGE VALUES FOR MILL OVER-RUN.

TABLE 35.—Mill over-run for 16' butt logs.
(Values read from curves shown in Figs. 203, 204, 205 and 206.)

Diameter breasthigh in inches	IMMATURE Y. P. BUTT LOGS			MATURE Y. P. BUTT LOGS		
	Sawed out, bd. ft.	Log scale, bd. ft.	% over-run	Sawed out, bd. ft.	Log scale, bd. ft.	% over-run
20	207	153	35.4	212	159	33.3
21	226	169	33.6	236	179	31.9
22	247	186	32.3	261	199	31.0
23	269	205	30.9	287	221	29.9
24	292	226	29.6	315	244	29.0
25	317	246	28.7	344	269	28.0
26	342	267	28.0	374	294	27.3
27	371	290	27.4	405	320	26.5
28	399	315	26.6	437	347	26.0
29	430	340	26.1	470	375	25.3
30	462	368	25.7	505	403	25.2
31	497	395	25.4	542	434	25.1
32	531	424	25.2	580	466	24.5
33	570	455	25.0	620	498	24.4
34	608	487	24.8	661	532	24.3
35	650	519	24.7	706	569	24.2
36	691	554	24.7	752	606	24.0
37	736	589	24.6	798	643	24.0
38	781	627	24.6	845	683	23.8
39	829	664	24.5	896	723	23.8
40	876	703	24.5	948	766	23.7
41	926	745	24.4	1003	810	23.7
42	979	786	24.4	1058	856	23.6
43	----	----	----	1116	903	23.5
44	----	----	----	1175	952	23.5

TABLE 36.—*Mill over-run for top logs from immature trees.*

Diameter breasthigh in inches	Sawed out, board feet	Log scale, board feet	% over-run
20	46	26	77
21	46	26	77
22	48	26	84
23	49	27	81
24	50	27	85
25	53	27	96
26	54	28	93
27	55	28	96
28	57	29	96
29	59	30	96
30	60	32	88
31	62	33	88
32	63	34	85
33	65	35	86
34	67	37	81
35	69	39	77
36	73	41	78
37	[illegible]	45	77
38	[illegible]	45	76
39	[illegible]	47	[illegible]
40	[illegible]	[illegible]	[illegible]
41	[illegible]	[illegible]	[illegible]
42	[illegible]	[illegible]	80

GENERAL SUMMARIES

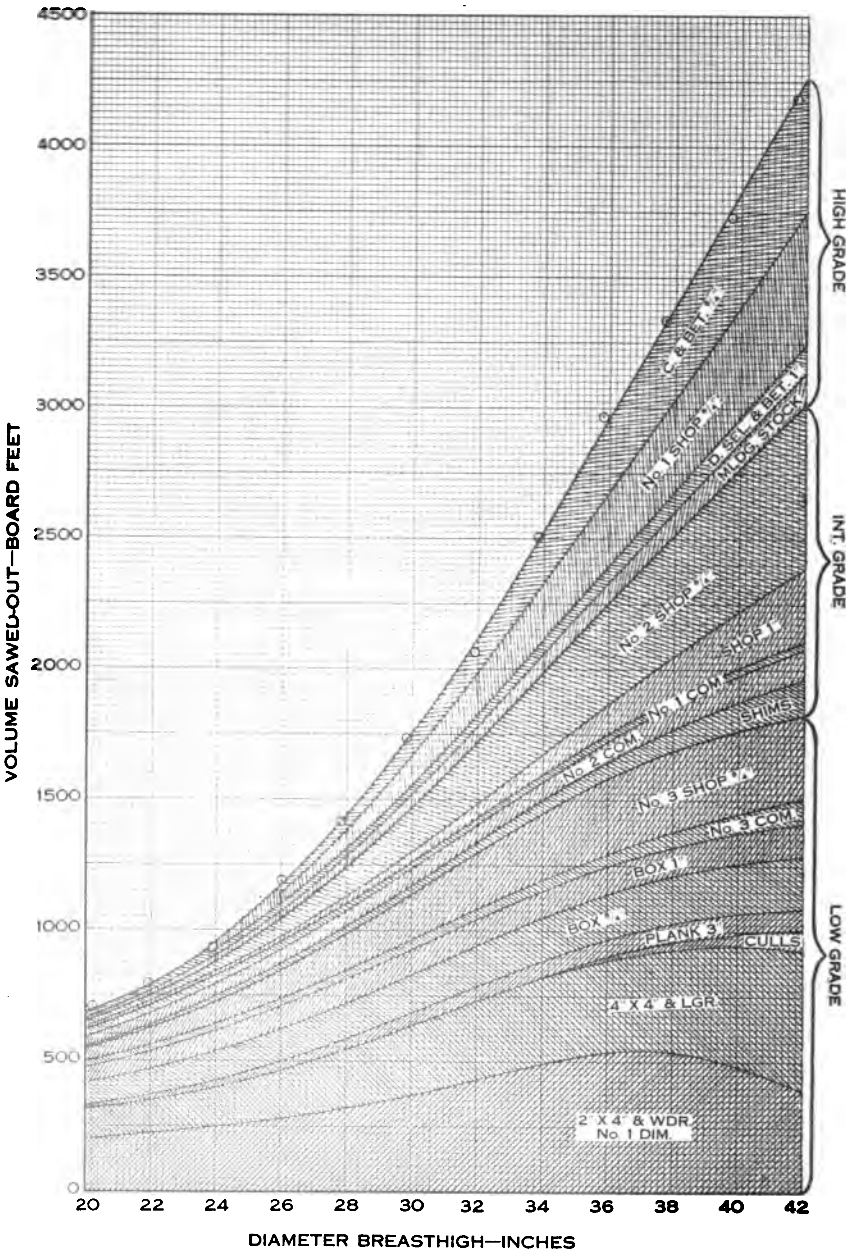

FIG. 209.—A graphic representation of the average volume in board feet of each grade sawed from immature trees of different diameters breasthigh. (Values given in Table 3.) This summary diagram shows at a glance the relative weights of the various grades, and is constructed by plotting the sum of the individual grades under the total sawed out curve. (The whole = the sum of all of its parts.)

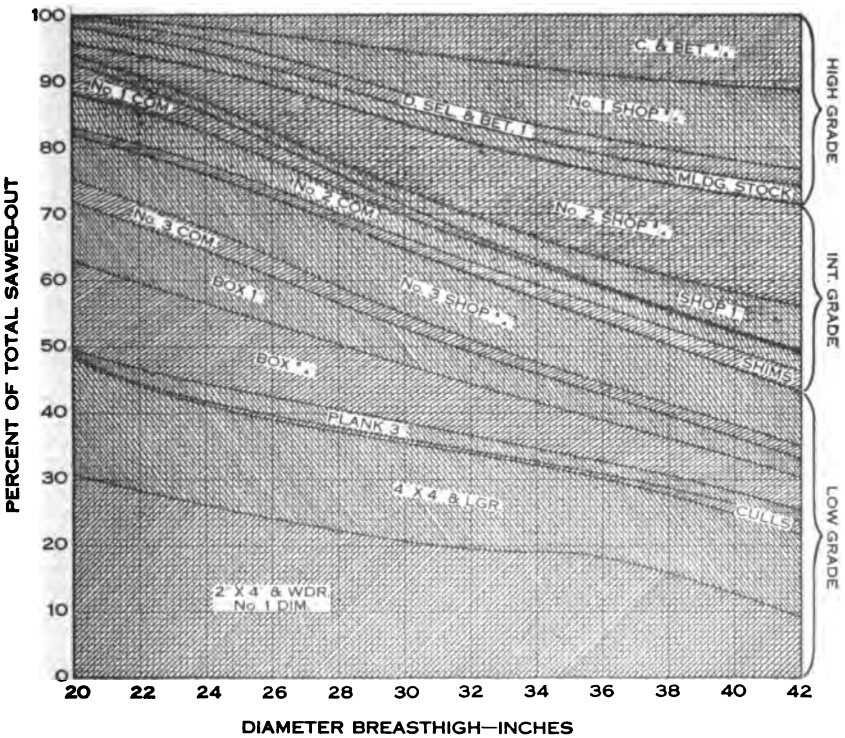

FIG. 210.—A graphic representation of the average per cent of each grade, based on total sawed out, from immature trees of different diameters breasthigh. (Values given in Table 5. This summary diagram shows at a glance the relative importance of the various grades, and is constructed by graphically adding the per cent of grades from trees of different diameters.

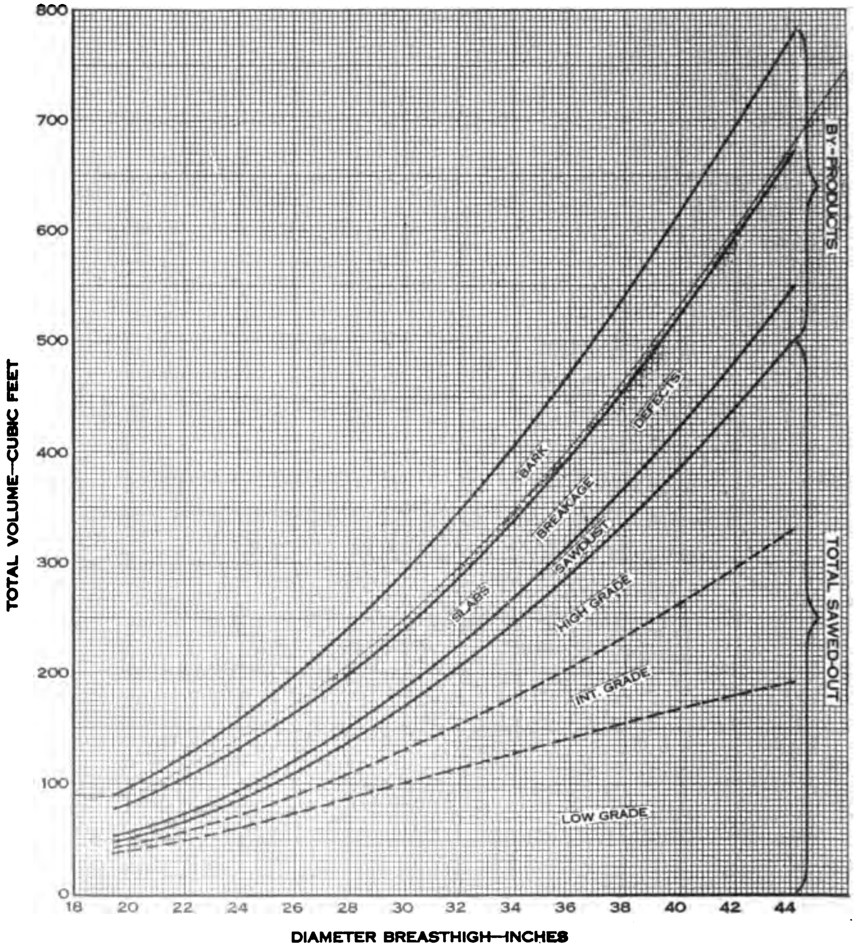

FIG. 211.—A diagram showing the average total yield in cubic feet of lumber and by-products from mature western yellow pine trees of different diameters breasthigh. (Values given in Table 37.)

Average total volume in cubic feet of wood and bark between stump and height where the tree is 6" outside bark.

- Total sawed out.
  - High grade lumber.
  - Intermediate grade.
  - Low grade.
- By-products.
  - Bark.
  - Slabs, breakage and defects.
  - Sawdust.

TABLE 37.—*The average total yield in cubic feet of lumber and by-products from mature western yellow pine trees of different diameters breasthigh.*
(A graphic representation of these values given in Fig. 211.)

Diameter breast-high in inches	VOLUME IN CU. FT. CONTAINED IN MERCH. LENGTH								Total sawed out + by-prods., cu. ft.
	Low grade +	Int. grade +	High grade =	Total sawed out	Sawdust from lumber sawed +	Slabs breakage and defects +	Bark =	By-products	
20	41	5	5	51	6	26	14	46	97
21	44	7	7	58	6	30	16	52	110
22	49	8	9	66	8	32	19	59	125
23	54	10	11	75	8	35	23	66	141
24	61	11	14	86	9	38	25	72	158
25	67	13	17	97	10	41	29	80	177
26	74	16	20	110	11	43	33	87	197
27	80	19	25	124	12	45	38	95	219
28	88	22	28	138	14	48	42	104	242
29	94	26	34	154	15	50	47	112	266
30	101	30	40	171	16	54	51	121	292
31	108	35	45	188	18	57	55	130	318
32	115	39	53	207	19	61	60	140	347
33	121	46	59	226	21	66	63	150	376
34	128	51	67	246	23	70	68	161	407
35	135	57	75	267	25	75	70	170	437
36	142	63	84	289	28	79	74	181	470
37	148	71	93	312	30	84	79	193	505
38	156	77	103	336	32	89	83	204	540
39	162	86	112	360	35	94	89	218	578
40	168	95	123	386	37	100	94	231	617
41	174	105	133	412	40	106	97	243	655
42	180	115	145	440	42	112	100	254	694
43	186	125	156	467	45	117	103	265	732
44	192	135	169	496	48	122	106	276	772

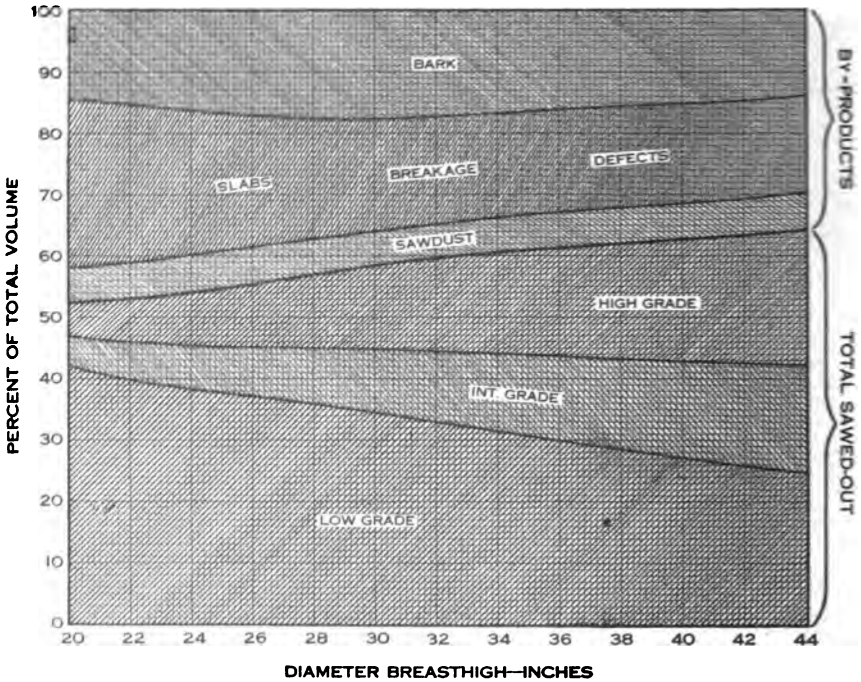

FIG. 212.—A diagram showing the yield of lumber and by-products, in per cent of average total yield, from mature western yellow pine trees of different diameters breasthigh. (Values given in Table 38.)

100 per cent.
- Per cent total sawed out.
  - Per cent high grade lumber.
  - Per cent intermediate grade.
  - Per cent low grade.
- Per cent by-products.
  - Per cent bark.
  - Per cent slabs, breakage and defects.
  - Per cent sawdust.

NOTE.—Average total yield = total volume of wood and bark between stump and a height where the tree is 6″ outside bark.

TABLE 38.—*The average yield of lumber and by-products, in per cent of average total yield, from mature western yellow pine trees of different diameters breasthigh.* (A graphic representation of these values given in Fig. 212.)

Diameter breast-high in inches	PER CENT OF TOTAL VOL. IN CU. FT. CONTAINED IN MERCH. LENGTH + BARK								Total sawed out + by-prods., cu. ft.
	Low grade +	Int. grade +	High grade =	Total sawed out	Sawdust from lumber sawed +	Slabs breakage and defects +	Bark =	By-products	
20	42.2	5.2	5.2	52.6	6.2	26.8	14.4	47.4	97
21	40.0	6.4	6.4	52.8	5.5	27.2	14.5	47.2	110
22	39.2	6.4	7.2	52.8	6.4	25.6	15.2	47.2	125
23	38.3	7.1	7.8	53.2	5.7	24.8	16.3	46.8	141
24	38.6	7.0	8.9	54.5	5.7	24.0	15.8	45.5	158
25	37.8	7.3	9.6	54.7	5.7	23.2	16.4	45.3	177
26	37.6	8.1	10.1	55.8	5.6	21.8	16.8	44.2	197
27	36.5	8.7	11.4	56.6	5.5	20.6	17.3	43.4	219
28	36.4	9.1	11.5	57.0	5.8	19.8	17.4	43.0	242
29	35.3	9.7	12.8	57.8	5.6	18.8	17.8	42.2	266
30	34.6	10.2	13.7	58.5	5.5	18.5	17.5	41.5	292
31	34.0	11.0	14.1	59.1	5.7	17.9	17.3	40.9	318
32	33.1	11.2	15.3	59.6	5.5	17.6	17.3	40.4	347
33	32.2	12.2	15.7	60.1	5.6	17.5	16.8	39.9	376
34	31.4	12.5	16.5	60.4	5.7	17.2	16.7	39.6	407
35	30.9	13.0	17.2	61.1	5.7	17.2	16.0	38.9	437
36	30.1	13.4	17.9	61.4	6.0	16.8	15.8	38.6	470
37	29.3	14.1	18.4	61.8	5.9	16.6	15.7	38.2	505
38	28.9	14.2	19.1	62.2	5.9	16.5	15.4	37.8	540
39	28.0	14.9	19.4	62.3	6.0	16.3	15.4	37.7	578
40	27.3	15.4	19.9	62.6	6.0	16.2	15.2	37.4	617
41	26.6	16.0	20.3	62.9	6.1	16.2	14.8	37.1	655
42	26.0	16.6	20.9	63.5	6.0	16.1	14.4	36.5	694
43	25.4	17.1	21.3	63.8	6.1	16.0	14.1	36.2	732
44	24.9	17.5	21.9	64.3	6.2	15.8	13.7	35.7	772

TABLE 39.—*Average determinations for immature western yellow pine.*

(Values read from curves shown in Figs. 4, 8, 22, etc., as indicated at bottom of table.)

DIMENSIONS			VOLUME IN BOARD FEET						VALUE				GROWTH IN			
													VOLUME		VALUE	
Diameter breasthigh in inches	Merch. length in feet	Vol. included in merch. length, cu. ft.	High grade +	Int. grade +	Low grade =	Total sawed out	As shown by Spaulding Log Scale	% overrun	Per tree	Per 1000 b. m. of merch. vol. of tree	Per 1000 b. m. of butt log	Per 1000 b. m. of top log	Board feet per dec.	% inc. per dec. based on total volume	Dollars and cents per dec.	% inc. per dec. based on total volume
20	84	80	29	95	561	685	430	59.0	$10.10	$14.75	$15.55	$13.25	50	7.4	$.80	7.4
21	87	89	39	105	590	735	470	55.5	10.90	14.85	15.95	13.25	55	7.5	.85	7.6
22	89	98	48	117	625	790	520	52.2	11.85	15.00	16.35	13.30	65	8.0	1.00	8.4
23	91	108	62	135	674	870	580	49.2	13.10	15.15	16.80	13.40	80	8.8	1.30	9.7
24	94	119	78	153	725	955	650	46.6	14.65	15.35	17.30	13.35	97	9.9	1.45	11.5
25	96	131	98	173	786	1060	735	44.1	16.30	15.55	17.90	13.35	116	10.8	2.15	12.9
26	99	143	125	196	854	1175	825	42.0	18.50	15.75	18.35	13.30	136	11.5	2.55	13.7
27	101	158	160	225	920	1300	930	40.1	20.90	16.05	18.95	13.40	155	12.0	2.95	14.0
28	104	173	202	255	988	1445	1040	38.5	23.60	16.35	19.50	13.60	174	12.8	3.35	14.0
29	106	189	243	292	1063	1585	1160	37.1	26.50	16.60	19.95	13.50	194	12.3	3.70	13.8
30	108	207	293	330	1133	1755	1300	35.9	29.55	16.85	20.45	13.45	210	12.0	4.00	13.5
31	110	225	348	371	1215	1925	1435	34.9	33.00	17.10	20.85	13.50	226	11.7	4.35	13.0
32	112	244	412	416	1291	2115	1580	34.0	36.65	17.30	21.15	13.45	238	11.2	4.60	12.4
33	115	265	474	471	1369	2315	1735	33.3	40.50	17.50	21.45	13.35	246	10.5	4.80	11.7
34	117	287	546	529	1451	2525	1900	32.7	44.75	17.70	21.80	13.30	250	9.8	4.95	11.0
35	119	309	620	594	1529	2735	2060	32.1	49.20	17.90	22.05	13.30	250	9.2	5.05	10.3
36	121	333	703	662	1595	2960	2230	31.8	53.50	18.05	22.45	13.15	249	8.4	5.10	9.5
37	123	357	782	738	1655	3160	2400	31.2	57.90	18.25	22.50	12.90	246	7.7	5.05	8.7
38	125	384	868	818	1701	3380	2580	30.8	62.30	18.40	22.65	12.90	240	7.0	5.00	8.0
39	127	410	951	904	1742	3600	2760	30.4	66.75	18.55	22.85	12.90	233	6.4	4.95	7.3
40	129	437	1043	995	1787	3825	2940	30.0	71.45	18.70	23.00	12.70	224	5.8	4.75	6.6
41	131	466	1182	1101	1808	4040	3120	29.8	76.00	18.85	23.05	12.70	214	5.2	4.55	5.9
42	133	497	1226	1198	1836	4260	3300	29.4	80.60	18.95	23.10	12.60	203	4.6	4.25	5.2
Figs.	4	8	22	34	52	11	10	200	68	70	70	70	87	88	91	92

TABLE 40.—*Average determinations for mature western yellow pine.*

(Values read from curves shown in Figs. 5, 9, 25, etc., as indicated at bottom of table.)

DIMENSIONS			VOLUME IN BOARD FEET						VALUE				GROWTH IN			
													VOLUME		VALUE	
Diameter breasthigh in inches	Merch. length in feet	Vol. included in merch. length, cu. ft.	High grade +	Int. grade +	Low grade =	Total sawed out	As shown by Spaulding Log Scale	% overrun	Per tree	Per 1000 bd. ft. of tree	Per 1000 bd. ft. of butt log	Per 1000 bd. ft. of top log	Board feet per dec.	% inc. per dec. based on total volume	Dollars and cents per dec.	% inc. per dec. based on total volume
20	83	83	58	69	500	625	410	52.0	$9.50	$15.10	$16.25	$13.60	31	5.0	$.60	6.0
21	87	94	67	78	558	715	480	48.5	11.00	15.50	17.25	13.70	34	5.1	.68	6.0
22	91	107	108	92	619	820	563	45.5	13.00	15.80	18.00	13.70	40	5.2	.72	6.2
23	94	118	130	110	692	980	655	43.0	15.00	16.05	18.75	13.70	50	5.4	.95	6.4
24	97	132	162	130	771	1060	755	41.0	17.30	16.30	19.35	13.60	60	5.7	1.15	6.6
25	100	148	194	156	856	1200	870	39.1	20.00	16.55	19.80	13.50	71	5.9	1.35	6.7
26	103	165	235	185	938	1360	990	37.5	22.75	16.80	20.25	13.40	82	6.0	1.60	6.8
27	105	182	285	220	1028	1525	1110	36.1	26.00	17.05	20.60	13.30	92	6.0	1.80	6.8
28	107	200	338	258	1109	1700	1255	35.0	29.40	17.25	20.90	13.25	101	6.0	2.00	6.7
29	110	220	396	301	1190	1880	1395	34.0	32.90	17.50	21.20	13.20	110	6.0	2.20	6.6
30	112	241	462	349	1276	2080	1555	33.1	36.80	17.70	21.45	13.20	120	5.9	2.38	6.5
31	114	264	537	401	1359	2290	1715	32.3	40.75	17.90	21.70	13.20	130	5.8	2.58	6.3
32	117	288	612	451	1442	2500	1895	31.7	45.10	18.10	21.90	13.20	139	5.6	2.75	6.1
33	119	312	695	516	1526	2735	2070	31.1	49.60	18.30	22.05	13.10	148	5.5	2.90	5.9
34	121	339	781	583	1609	2970	2265	30.5	54.60	18.50	22.25	13.05	155	5.3	3.08	5.7
35	123	366	872	661	1688	3220	2465	30.1	59.75	18.65	22.40	13.00	162	5.1	3.20	5.4
36	125	395	977	744	1764	3480	2680	29.6	65.40	18.75	22.50	12.95	169	4.9	3.35	5.2
37	127	425	1081	830	1846	3750	2890	29.2	71.00	18.90	22.60	12.90	175	4.7	3.50	5.0
38	129	457	1191	917	1924	4030	3130	28.8	76.85	19.00	22.75	12.85	180	4.5	3.65	4.7
39	131	488	1299	1012	2007	4320	3360	28.5	83.00	19.15	22.85	12.80	184	4.2	3.75	4.5
40	133	523	1425	1120	2085	4625	3620	28.1	89.25	19.25	23.00	12.70	188	4.0	3.85	4.3
41	135	558	1545	1226	2167	4940	3870	27.9	95.80	19.35	23.15	12.65	190	3.8	3.92	4.1
42	137	595	1679	1340	2256	5270	4140	27.6	102.50	19.45	23.30	12.55	190	3.6	4.00	3.8
43	138	630	1812	1462	2329	5590	4400	27.3	109.30	19.50	23.45	12.50	190	3.4	4.03	3.6
44	140	667	1948	1586	2401	5930	4670	27.0	116.25	19.55	23.50	12.45	191	3.2	4.05	3.4
Figs.	5	9	25	37	53	13	12	202	69	72	72	72	89	90	93	94

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